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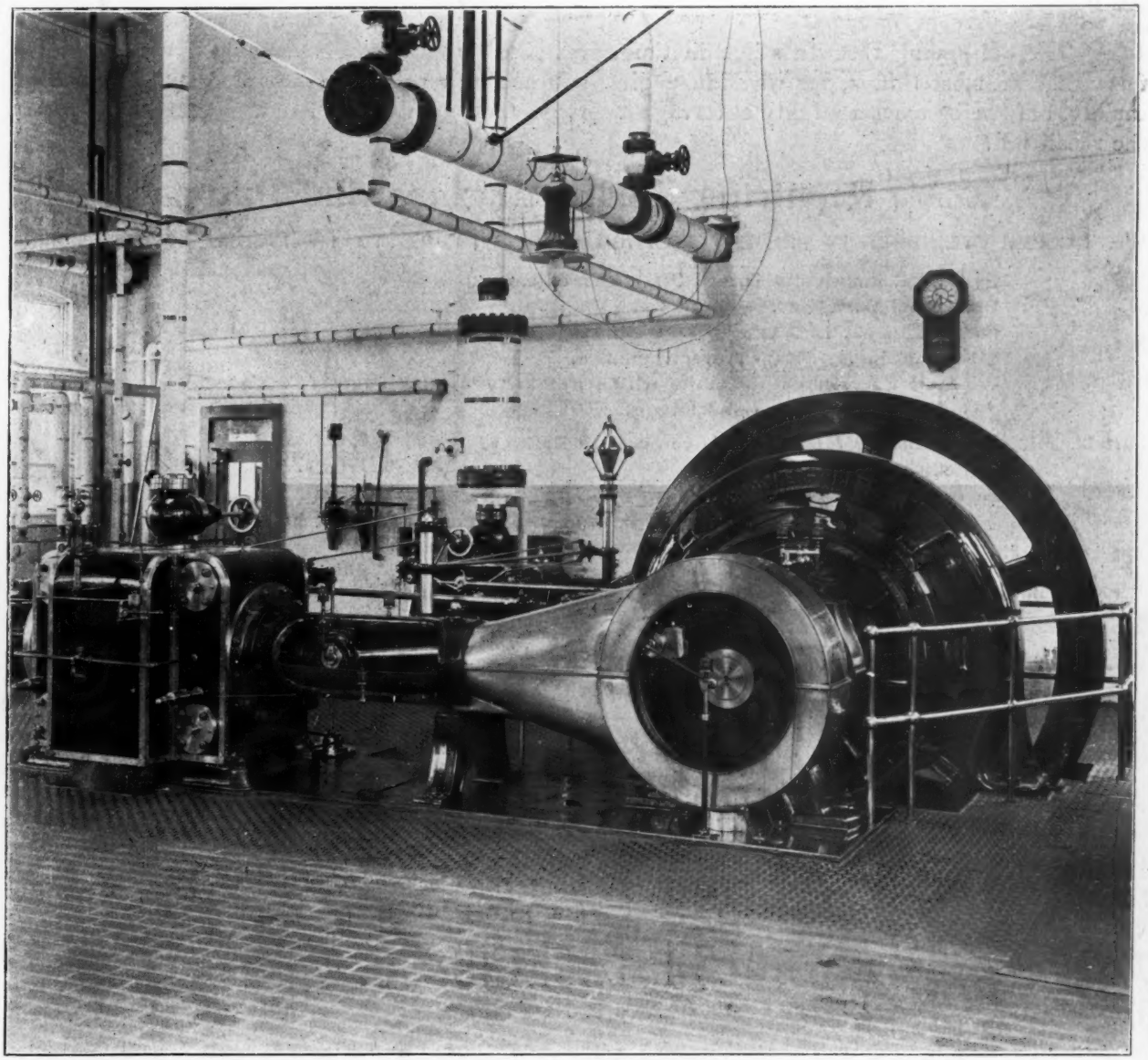

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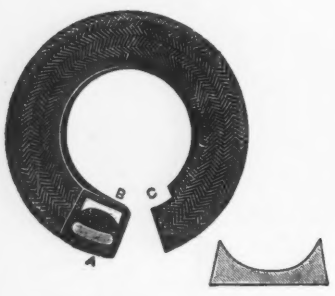

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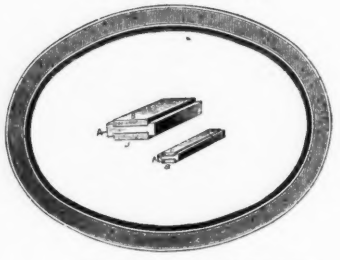

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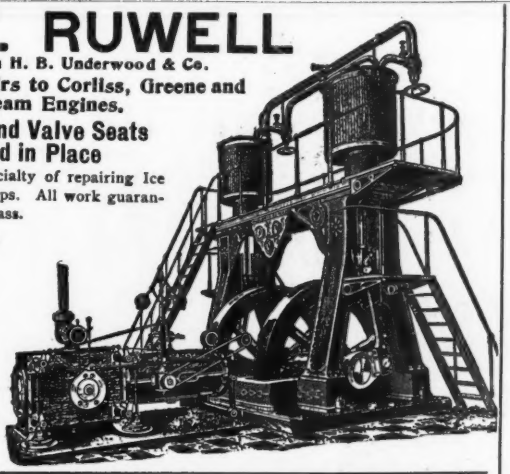

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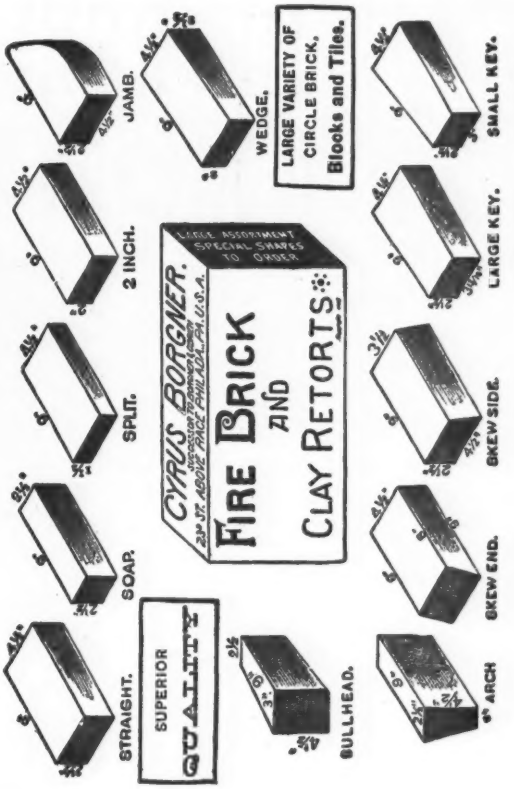

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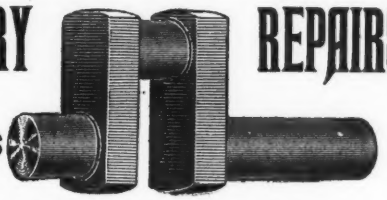

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The
Practical Engineer

A monthly journal, devoted to the economical generation and utilization of power and to the interests of stationary engineers

VOL. VII PHILADELPHIA, OCTOBER, 1903 No. 9

White Coal of the Alps

A. G. WILLIAMS.

Glacial falls being converted into power for factories. *New York Times*, Jan. 25, 1903.

One of the most remarkable feats of engineering now being undertaken in the world is the conversion of the glacial falls of France and Switzerland into power with which to operate mills, factories and electric plants. The glaciers have been called a "mine of white coal," which, unlike the product of the earth, is inexhaustible, renewing itself from year to year. Some very interesting facts as to what has already been accomplished are contained in a report to the State Department, from United States Consul C. P. H. Nason, of Grenoble. "The streams and cascades have been used to a certain extent for years," says Mr. Nason, "but not until recently under the leadership of such enterprising men as Berges and Joya and Despres, has this water been 'canalized'—conducted by huge pipes from vast heights down the mountain sides, and with the aid of turbine wheels, made to develop tens of thousands of horse-power, and to distribute energy, heat and light in all directions.

In 1863 it was considered a bold achievement to bring water from a height of 260 feet, as at Uriage, but now M. Berges has succeeded in canalizing a fall of 1,604 feet, and another of 1,804 feet. At Epierre (Savoie) M. Joya used a fall of 1,935 feet, and at Chapareillan (twenty-five miles from Grenoble,) another of 2,040 feet, until this year said to be the highest fall in the world.

Mr. Nason says that the water at Lancey, near Grenoble, gives power to mills, of various kinds, and to the electrical plants which lights the valley of the Graisvairdan, and maintains its several tramway systems. The water here is brought by three successive falls whose total is 1,500 feet. Light is also furnished to the farm houses of the neighborhood at moderate cost.

Starting from the little lakes of Domenon, "continues Mr. Nason, "among the snows of the peak of the same name, the water is drawn by pipes which tap the water at its bottom, and is carried to a lake lower down the mountain, and from this still further down to a third lake, whence the conduits bear it, always at a certain gradient, to the factories below, where it yields the equivalent of 10,000 horse power. As illustrating the enormous pressure of the water thus canalized, the pipes in many cases (as below) are as much as 3 meters 30 millimeters or 10.83 feet in diameter. The tunnel under the Thames, in London, has a diameter of about 11 feet, but this is for a distance of 30 meters or 985 feet only. The Socrete Hydroelectrique de Fure et Morge at Grenoble, which utilizes the waters of the torrent Drac near Vizille, has 4,000 meters, or 15,092 feet (of which 8,200 feet are in steel plates and 6,892 feet in wired cement,) of piping with a diameter, as stated, of 10.83 feet.

This installation permits the distribution of force to the extent of 3,500 h.p. under a tension of 26,000 volts for a distance of forty miles, to factories in Morians, Voiron and Rives.

Grenoble will soon be lighted by electricity, the power being supplied by the electro-chemical society of the Romanche, which has its works in the village of Livet (altitude 1,794 feet) twenty-seven miles distant from this city. The valley of the Romanche was, until recent years, sparsely populated; to-day within a distance of twelve miles there are already installed six establishments for the making of paper, woodpulp, acetylene, aluminum, etc., and for the generation of electric force.

The stream itself is fed by the powerful glacial reservoirs of the Massifs of the Bellidonne and the pelooux ranges of mountains (in altitude from 9,800 to 13,000) feet on either side of the valley, and in winter and summer alike this water supply is unremitting and abundant.

So notable have been the achievements in and around Grenoble that there was recently held there "a white coal" convention. More than 500 prominent engineers and scientists from France and other countries assembled to examine and discuss the utilization of the water power of the glaziers and mountain streams of alpine France.

That very great possibilities may follow this investigation and study is evident from an estimate recently made of the total energy employed in all industries in France. This sum, as produced, by steam is 6,500,000 h.p. M. Berges, according to Consul Nason, estimates the hydraulic forces of France, in her mountainous regions, to be 10,000,000 h.p. To distribute this power over France would mean as much there as would the distribution of the power of Niagara over the State of New York and the surrounding country.

To understand the meaning of glacial formation, I will explain briefly what it is. A glacier is a river of solid ice from

two hundred to five thousand feet deep, having its rise in some mountain region among the heights where there is perpetual snow, and by the constant accumulation, always going on, the increasing weight of snow, at a low temperature, becomes solid ice and slowly falls down the mountain sides, as a frozen stream of water, grinding the rocks into mud and pebbles, and detaching large blocks of stone which are finally deposited as the ice reaches a lower and warmer level.

The earth's shape is an oblate spheroid flattened at the poles and bulges out towards the equator. The atmosphere is an oblate sphere of elastic gases, flattened at the poles and thrown off from the poles to the equator.

It is estimated that the depth of the air is forty-five miles. This will give an idea of the shape of the atmosphere. It is flattened at the poles and the earth's centrifugal force throws it from the centre of rotation with sufficient force to leave an airless pole in the arctic and antarctic zones, where perpetual ice and snow reigns supreme. No air, no water, all frozen solid as a perpetual sea of ice.

The ice accumulates and forces its way to the warmer regions and falling into the sea is broken up into hugh masses or icebergs and in their progress towards the equator melt and become part of the ocean waters from which they were formed.

The atmospheric shape can be readily understood by studying the altitude of the snow line. At the poles it is at the sea level, rising gradually until it attains a height of 16,000 feet. Thus we find mountains at different altitudes are covered with perpetual snow, rising from the sea level to 16,000 feet, according to latitude.

The atmosphere is the great water carrier. It is forced from the poles as a dry cold wind saturated with electricity, and by the well-known law of centrifugal force flies from the central pole in a curved direction from North to West, in the form of North and Southeast trade winds. Two great polar drifts of air at a low temperature thus flow from each pole, expand as they pass over the warmer latitudes, sucking up by evaporation, moisture, until the two great currents meet at the equator, and are forced upwards and return to the poles again as Southwest counter trades. These return winds rise above the 16,000 feet snow-line, the watery vapor they contain becomes frozen as very minute snow which is often perceptible as light fleecy, cirrus clouds, in their course back to the polar regions, every mountain top above the mean snowline is supjected to a constan bombardment of this fine snow, and which is deposited always on the Southern slopes, never on the North side.

The greater portion of this vast stream of frozen vapor, however, is deposited on the polar ice caps again, forced down to the lower sea level ; melting again, resumes its equatorial course. In this wise the air and water performs a constant circulation from poles to equator back again to the poles, and is the never failing source from which we derive "The White Coal," supplied by every mountain range above the line of perpetual snow and frost.

The atmosphere at the sea level is warm, but for every 300 feet it drops one degree Fahr., varying, however, according to latitude.

Is not this a beautiful instance as illustrating the law of the correlation of physical force. Cold converted into heat performs work, and an exact amount of energy is stored up as the temperature is lowered by conversion of heat into cold..

Black coal is burnt to evaporate water into steam, it is condensed and cooled as quickly.

The atmosphere is at once a refrigerating plant on a vast scale, it is an automatic engine, a product of the earth's revolution on its axis, which develops its internal heat by friction against an ether-adamant (the Interstellar Medium) the earth's heat supplies the expansive force maintaining water and air in liquid and gaseous forms, and its rotation keeps the oceans of water and air in constant movement transferring energy to every part of the world.

Heat and cold are the two positive and negative physical forces synonymous with the electrical terms positive and negative. Heat a pushing and cold the pulling force, and in the inverse ratio the conditions are reversed. Heat produces cold and cold produces heat. The push becomes a pull and *vice versa* in an endless chain.

Is it not a consoling thought, that when our supply of coal is exhausted, as it inevitably will sooner or later, that we have another coal field to draw from which requires, like the black coal mines, pits and tunnels to be driven, to tap a constant supply of white coal, moreover with the advantage of smokeless energy, the atmosphere, instead of being polluted by dense evil smelling clouds of black smoke, and carbonic acid gases, will become as pure as the primeval air ?

Hydro-electric power in central and auxiliary plants, wherever water available, will thus change the conditions. Factories instead of concentrating in crowded cities will be scattered all over the country. Wind power and storage batteries will also become valuable auxiliary power, individual installations in houses and farms will assist in this segregation and dispersal. Factorics will be built where the raw material is grown. Sugar mills on the sugar plantations. Foundries and smelting works at the mines. Cotton mills and textile manufactories in the cotton fields, etc., with an enormous economy in the transit, the finished pruducts transferred by the same energy that produces them. Electric railways are even now rapidly replacing the steam.

Towns and cities will disappear, leaving the seaports as their only representatives. The country will afford long-suffering denizens of our great crowded cities, homes in the pure air of the country. Their employment at their doors.

The development of the white coal energy will also necessitate a complete system of irrigations further assisting in solving the transit problems. Canals, both for irrigation and navigation, and incidentally water-power, will, moreover, prevent disastrous floods by providing adequate outlets for the accumulation of water. Rivers can be utilized by a general system of locks and dams, floods in the lowlands will become a thing of the past, by embankments where needed. Thus the floods will be held in reserve, agriculture will be independent of rains, and an enormous amount of hydraulic power rendered available all over the country, which now runs to waste.

The tides will also be utilized. Nature's forces, which now are allowed to expend their energies in destruction of life and property, will be useful in preserving both. An ideal garden of Eden will prevail, but the necessity for work will be more evident than ever, to maintain this ideal condition.

Concentration of both capital and labor will no longer exist. Gigantic trusts will no longer be possible, the struggle between labor and capital will become a tradition.

The *White Coal* will in this wise change the whole world.

This is no dream, it is surely coming, in fact it is here. Niagara Falls power, the Swiss and French hydro-electric installations, etc., are the advanced guards in this revolutionary march.

The historic land of Egypt is a vivid object lesson in this much-to-be-desired realization. The great barrage system on the upper Nile obviates floods or low water. The waters of this great river are held in control and used when needed. The cultivation of the land is aided and its area immensly increased.

The hitherto waste sandy deserts are becoming smiling verdue-clad expanses, independent of rains or floods.

The Nile's source is the white coal of the great central mountains of Africa. America has an inexhaustible supply of White Coal too. Its mighty rivers are in like manner supplied by the White Coal of the great backbone of the land, the snow-clad Rocky Mountains.

We may call this a return of the world to the great glacial age, but with a vastly different result.

The Refining of California Petroleum.

By Dozier Finley.

The character of California oil is different from all the oil which has previously held the name of petroleum in America. To appreciate the difference it is necessary to compare the California oil with the older and better known oils of Pennsylvania, Ohio, New York and Virginia. The petroleum of the Eastern States consists largely of a series of methanes or paraffines, compounds of carbon and hydrogen in which the algebraic proportion $C_n H_{2n}+2$ is rigidly preserved. This oil is characterized by the lightness of its specific gravity in relation to its boiling point, by its marked resistance to the attack of many strong chemical disintegrating processes and by the fact that the heavier portions are partially crystalline at ordinary temperatures. The proportional admixture of the constituents of particular boiling points is characteristic. A flask distillation of a common Eastern crude oil gave:

Gasoline—B. P. to 100 deg C	4 per cent
Benzine—100 deg. to 150 deg. C	10 per cent
Coal Oil—150 to 270 deg. C	50 per cent
Intermediate Oils—270 deg. to 310 deg. C	17 per cent
Lubricating Oils—300 deg. upward	16 per cent
Paraffine—Extracted	1 per cent
Coke and loss	2 per cent
	100 per cent

Another characteristic is that in refining on a large scale as high as sixty-five or seventy per cent. of illuminating oil is obtained instead of the fifty per cent. as given above. This is due to "cracking," a process applicable only to paraffine oils.

The petroleum of Russia is far different from the Pennsylvania oil, but very similar to the California oil. The Russian oil has found an extended use but has been developed in a manner somewhat different from the Eastern oil and does not compete with American oil except in certain parts of Europe.

California oil consists to a great degree of naphthenes, compounds of hydrogen and carbon, in which the proportion is $C_n H_{2n}$. The density of naphthene compounds is greater than that of the paraffines of corresponding boiling points or of the same number of carbon atoms. Naphthenes are not so resistant to chemical disintegration as are paraffines. Though California oil yields a solid residue of asphaltum, neither from the residue nor from the distillates can be obtained the solid crystalline paraffine characteristic of Eastern petroleum. The proportion of various oils obtained in a laboratory distillation shows a marked contrast to the proportion obtained from Eastern oils. The following is taken from an oil commonly used for refining in the San Joaquin valley region:

Gasoline—to 100 deg. C	1 per cent
Benzine—100 deg. to 150 deg. C	4 per cent
Coal Oil—150 deg. to 220 deg. C	10 per cent
Pyronaphtha—220 deg. to 260 deg. C:	10 per cent
Gas Distillate—260 deg. to 310 deg. C	20 per cent
Heavy Distillate for Fuel or Lubricating deg. C. upward	37 per cent
Asphaltum—Grade D	18 per cent

It will be noticed that the boiling points of California oils differ from the like constants of similarly named Eastern products. In the refineries on this coast "cracking" is not practiced and consequently the results of a laboratory test correspond well with the refinery distillation save that the heavier portions are apt to "crack" in the distillation flask unless steam be introduced.

California petroleums from certain districts are almost or quite identical with the Eastern petroleum, but these district are small and the product finds only a very local use. However, many well drillers hope to discover large bodies of paraffine oil on the Pacific Coast, and their hopes will probably be realized at some time.

Having defined the character of our local oils, their application is of next importance. The crude oil, as such, is capable of only limited application; it makes an excellent and cheap fuel; it has been found of use in road making, and recently crude oil has been applied to metallurgical processes. But in the refinery products of such diverse natures may be prepared as such moderate cost that it is not strange that the refinery should be an attractive field to commercial men and technical chemist.

The location of refineries in California is determined by transportation rates and marketing advantages. Refineries located in or near Los Angeles may take advantage of the two factors —nearness to the wells and proximity to the market. In the Bakersfield region many refineries are operating for the production of asphalt, which is shipped to the East, while the distillate is sold, without further separation, as fuel or gas-making oil. To supply the market at San Francisco many refineries are located around the bay, receiving their oil from the wells either in tank cars if from the San Joaquin valley, or in tank steamers if from the Southern California coast oil fields.

Refining equipment consists of storage tanks connected by appropriate pipe lines, water supply, steam plant, pumpign machinery, cooperage and, as essentials of refining, stills, condensers, residuum coolers and agitators. This equipment varies in detail with the variety of oil to be refined and according to the products desired.

Storage tanks range in size from forty-two thousand to a million and half gallons. The amount of the crude oil tankage depends on the size of the refinery and the rate of suppy; the capacity of the storage for finished oil depends on the size of the refinery and the rate of marketing. Usually tankage should be provided to store sufficient crude oil to last one month and enough storage reserved to receive one month's production of each kind of oil. The tank is characteristic of tank fittings. A cock is provided for drawing off water from the bottom

and a swing pipe is so attached as to keep the suction in the settled oil in the upper portion of the tank. Occasionally the oil is so viscous that a steam coil is placed in the tank to facilitate pumping by heating.

Boiler capacity, water supply, pumps and piping are governed by the amount and character of the oil handled. The boiler capacity is not less than one hundred horse power per thousand barrels still capacity. The water supply varies with the method of condensation, but twenty thousand gallons per hour is ample for one thousand barrels still capacity. Cooling ponds may be used to economize the water supply. Oil pumps rarely have to work against great pressure, hence they are of the light service pattern. Crude oil pumps may be of the medium service pattern, while residuum and heavy crude oil pumps must be of the high pressure design. Compound steam pumps may be used to advantage in larger refineries. Cooperage is essential for shipping, glued barrels being used for the finished oils and light pine sugar barrels for asphaltum.

The still is the first essential of the refinery. It varies from a few barrels capacity to a thousand barrels. In all sizes the construction is similar. The shape is cylindrical, the length slightly exceeding twice the diameter. At the top is placed a vertical cylindrical dome equal in height and diameter, these dimensions being about one-fourth the diameter of the still. Through the dome the vapors pass to the pipe leading to the condenser. On the dome is also placed a pressure safety valve. Manholes at the top and one end of the still facilitate cleaning. Perforated pipes distribute superheated steam in fine jets on the inside of the still and prevent the asphalt from coking on the bottom. Tricocks are placed at one end so that the stillman may ascertain the level of the mixture within and test the residuum. Pipes for pumping in oil are provided and cocks are suitably placed for withdrawing the residuum into the coolers. The absence of flues in the still causes great waste of heat but flues would be liable to burn out when the oil level fell below them. Fuel usually consists of residuum or unsalable distillate, which, being quite light, flows by gravity to the burners and supplies antexcellent fire which requires little attention from the stillman.

The residuum cooler is placed below the level of the still so that the residuum flows in to the cooler by gravity. To prevent ignition of the highly heated oil drawn from the still, a live steam pipe allows the air in the cooler to be displaced by steam. In case asphaltum should harden in the cooler, a method of melting the mass is necessary, either by fire or superheated steam.

The vapor pipe from the stills ranges in diameter from fifteen inches for a one thousand barrel still to five inches for a one hundred barrel still. This pipe is carried to the condenser, usually an iron or wooden box filled with circulating water and containing the condensing coils. These diminish from the size of the vapor pipe to one-third its diameter. Usually seven square feet of surface are provided to condense and cool each barrel of oil in twelve hours. At the end of the condenser an automatic trap resembling a plumbing trap separates the oil from the gas usually attending it. The oil is then conveyed to a building called the "tail house," where the stillman, by a convenient device, diverts the flow of oil from tank to tank during the progress of the run. Here, also, are located the hydrometers and testing instruments used by the stillman.

The methods of refining vary with the crude oil used and the character of the products produced. Great secrecy is preserved by refiners concerning their methods, but the operations are so very simple compared to many of the processes daily carried out in technical chemistry that it appears refiners mystify a mere nothing in order to make their accomplishment seem profound. Care and cleanliness are required in the handling of the oils and every attention must be given to the distillation, in particular. The entire refinery operation reminds one strongly of the ordinary manipulation processes in organic chemistry, and it is found that refining petroleum is as easy to carry out as is the purification of some of the simplest compounds as prepared in the laboratory.

The oil as it runs from the stills is separated into a limited number of fractions. The light oil, which distills over first, is separated for redistillation. As the distillate running from the stills gradually becomes more dense and rises in boiling point it is changed from tank to tank, the amount allowed to run into each tank being determined by the market demand for that particular distillate, both as regards quantity and quality. Certain of these distillates may be sold as such, hence the specific gravity of the oils running into the tanks containing these distillates must give an average specific gravity conforming to the demand of the refinery's customers. If the oil is to be redistilled, the specific gravity of the first distillate is of small importance provided that the oils to be removed on redistillation are run into the first distillate. Any detailed scheme of separation of distillates would be out of place here since each refinery employs a different system, producing the oils it can sell most readily. Roughly, the market grades are: gasoline, benzine, coal oil, pyronaphtha or engine distillate, gas distillate, neutral oil, lubricating oils. These run off successively in the order named and following each other without perceptible breaks. Indeed, the point where the distillate is changed from one tank to the next is perfectly arbitrary and is determined at will by the refinery superintendent or foreman, to suit the quantity or quality of production.

So far as actual operation is concerned the stills are pumped nearly full and the fires started. In six or ten hours the gasoline begins to distill over and the distillation is allowed to proceed slowly until the stills are nearly half emptied. The fires are then slackened, and when the distillate has decreased its flow sufficiently, steam is admitted to the still in a small quantity. After the first gush of oil has subsided the fires are again increased and the flow of steam is increased as the run proceeds. When a test sample of the residue in the still shows the nearly proper consistency in cooling in water, the fires are slowly decreased and gradually stopped, while the remainder of the run is finished by the steam and the hot furnace walls. Steam is gradually closed off as the flow of distillate slackens and is finally entirely stopped. The time of distillation proper ranges from twelve to eighteen hours, according to the size of the still. After the process is completed, the residuum is allowed to remain in the still from two to five hours and is then drawn into the cooler. The stills are allowed to rest for a short period and are then refilled for the next run. The entire operation may take either twenty-four or forty-eight hours, according to the size of the stills.

The lightest portion of the distillate, including the gasoline, benzine, coal oil and tailings of higher oils, is usually redistilled in order to procure lighter-colored products. The lightest portion from this second distillation may be redistilled in a column still similar to the alcohol stills, in order to obtain gasolines and benzines of more uniform composition. The

coal oil is usually obtained entirely from this second distillation. Other crude distillates may be redistilled, particularly the last distillates, to secure lighter-colored lubricating oils.

Owing to its constitution, California petroleum does not reach a temperature of decomposition until the heavier oils are distilling. Eastern oil undergoes decomposition at the high temperature required to distill its coal oil. In the East the decomposition is allowed to proceed and the decomposition product is coal oil. Here decomposition or "cracking" is not encouraged, since it does not improve the heavy oil and also causes a loss of fuel as the process is carried out in unjacketed stills with long-continued action of small fires.

The gasolines, benzines, coal oil, some of the engine distillate, the neutral oil and lubricating oils are pumped to the agitator plant. The agitator, is a vertical cylindrical tank with conical bottom and lined with lead. The capacity ranges from twenty to one thousand five hundred barrels, according to the size of the refinery. A compressor delivers air through a central pipe reaching to the bottom, and thus produces agitation of the oil and reagents. Acid and soda are pumped or blown over the top edge. A rose nozzle at the top is provided for washing. At the bottom the acid and soda may be withdrawn by a large three-way cock. The water overflows at a side pipe in such a manner that it is removed as quickly as it collects at the bottom, and still if the stream of water is stopped at the top the oil cannot escape owing to the balancing water column in the pipe. The finished oil may be pumped out by a suction line connected from the bottom of the agitator to a pump.

In operation the agitator is filled to within two feet of the top and sulphuric acid of ninety-eight per cent., or higher purity, is added in successive portions, each portion being withdrawn before the next is added. The first portion removes the water which may be present and, when not much diluted, often acts on the oil, becoming dark and thick. Succeeding portions act on the unstable products of the oil and remove them. Sulphurous acid is evolved, the oil becomes red-colored and the acid thick and tar-like. Finally, if the process be carried far enough, as it often is with coal oil gasolines and benzines, the acid no longer has any effect on the oil. The acid is then thoroughly settled out and withdrawn. The oil, if coal oil or a lighter product, is left pinkish but soon becomes dazzling white under the action of the wash-water from the rose nozzle. After settling and withdrawing the water, the oil is subjected to treatment with caustic soda solution in sufficient quantity to neuralize the remaining sulphuric acid and to remove organic acids present in the oil. Removal of the soda and soapy matter is followed by thorough washing, until the oil is neutral, to test reagents. After settling the last traces of water, which may require two or three days, the oil is ready for marketing.

The chemical treatment of the other oils is similar. Gasoline and benzine require as little as one-half per cent. by weight of acid to effect complete chemical reaction with all undesirable substances held in solution. Some lubricating oils require over fifteen per cent. of acid and even then will react with a further quantity. The light oils are usually allowed an excess of acid, while the heavier oils, owing to their large content of unstable compounds, are never completely freed from these compounds by the acid treatment. It is very simple to obtain satisfactory results with light oils, but the heavier oils are difficult to settle after treatment with soda and washing with water. Settling of lubricating oils is generally effected by heating in shallow tanks or sometimes by mixing with absorbent earths and separating with the filter press.

The finished oils from the agitation department differ greatly from the crude distillates from the stills. Before treatment, coal oil distillate is yellowish, sometimes brownish, has a heavy black sediment, an unpleasant odor, is unstable towards light and oxidation and has a low fire test. After treatment it is perfectly clear, water white, has the pleasant coal oil odor, a slight blue florescense, is perfectly stable towards oxidation, is permanent in color and is of satisfactory fire test. Indeed, it is so clear and colorless that small objects on the bottom of a tank may be seen in their true colors through a layer of coal oil twelve feet deep. Lubricating oil, before treatment, is almost black, foul smelling, foul tasting, often deposits muddy sediment and oxidizes to a hard skin on glass containing-vessels, is corrosive towards iron and is thoroughly unfit for lubrication. After treatment it is yellowish or red, pleasant smelling, sweetish to the taste, deposits no sediment, is non-corrosive and thoroughly fitted for its purpose.

The finished oils, whether distillates from the stills or thoroughly refined oils from the agitator plant, are sold in cans, barrels, iron drums or tank cars, according to demand. Much distillate is pumped into the same cars from which crude oil has been emptied. Such distillate is used for fuel. In contrast to this, the chemically-treated oil is shipped in thoroughly clean packages, occasionally in tank cars cleaned for the purpose.—*The California Journal of Technology.*

New Features Recently Added to Searchlights

By an attachment recently made in searchlights it is possible to direct the rays in a thin pencil or disperse the light over a great field. This is done by the means of dispersing lenses. These lenses are mounted on two light semi-circles of brass, as shown. These semi-circles are pivoted so that they may be rotated through an angle of 90 degrees, or a quarter circle. Two small handles on the top of the cylinder are for turning the lenses. When placed in the first position the lenses present a surface only one-half inch thick to the rays of light. This small amount of surface detracts nothing from the brilliancy of the light, which emerges in a solid straight beam. By turning the handles through an arc of a circle of 90 degrees the lenses are swung around. All the light has to now pass through the lenses, and it is spread out according to the curvature of the lenses.

It might be added that the dispersion lenses are permanently mounted in the searchlight cylinder, and trimming, cleaning, etc., are readily accomplished without removing them. The door containing the plane glass is left in position and not removed at all.

A Great Machine Exhibit

A Demonstration of the Recent Strides in the Development of Power Generation.

Lieutenant Godfrey L. Carden has recently returned from Europe, where he was engaged in securing exhibits for the World's Fair, and in particular with reference to the power plant which will be utilized for performing the various functions of the exhibition.

The total floor space in Machinery Hall, and in the adjoining "Fuel Gas and Steam Building," will approximate 9½ acres, and the space in Machinery Hall proper has been applied for some five times over.

The great power plant of the exposition will embrace more than 60,000 h.p., and of this amount about 53,000-h.p. has, so far, been assigned work. The items comprising the power plant embrace the latest types of engines known in the world to-day. Many of the prime movers could not have been seen at the Paris Exposition because of the lateness of the designs presented. It is a fact that more horse-power was offered for use at St. Louis by foreign manufacturers than could be availed of. The chief of the Machinery Department is Thomas M. Moore. This gentleman had charge of the machinery exhibits at the Pan-American Exposition and at the close of the Buffalo show he was called to St. Louis to take charge of the World's Fair machinery display. Lieutenant Carden is the officer who had charge of the ordnance division at the Pan-American Exposition, and at the close of that affair he was assigned to duty at St. Louis by order of the Secretary of the Treasury. Under Mr. Moore's instruction Lieutenant Carden visited during the past year the majority of the principal iron and steel and machinery houses in Europe and secured the engines and their accessories which will constitute the foreign section of the power plant.

Lieutenant Carden said that the gas engine display will be of especial interest. At the Paris Exposition he declared the largest gas engine exhibited was one of 600-h.p., and a year later, at the Pan-American Exposition, an American firm presented a 600-h.p. gas engine. At the World's Fair in St. Louis the Societe Anonyme John Cockerill, of Seraign, Belgium, will install a 3000-h.p. gas engine. This will be the largest of its type in the world at the time of its installation in the spring of 1904. A German firm will install a gas engine of 1750-h.p. It is interesting to note that the Germans claim that the 1750-h.p. can be developed on 1575 pounds of anthracite coal per hour, which is equivalent to less than one pound of coal per horse power per hour. There will be a number of other notable installations of gas engines.

In the turbine engine list there will be found a 5000 K. W. Curtis engine, a 5000-h.p. Parsons type engine, a 300-h.p. DeLaval engine from Stockholm, Sweden, and a 300-h.p. turbine from Leeds, England.

The foreign offerings of steam engines include a 1500-h.p. vertical triple expansion engine from Delaunay-Belleville, of Saint-Denis (sur Seine), France, and which includes engine, boilers and generator; a 1000-h.p. Willams & Robinson engine from Rugby, England; a 1000-h.p. engine from Societe Alsacien des Constructions at Mecanques, of Mulhouse, Germany, and a generator from the Belfort branch of the same house.

In addition to the prime movers of the power plant a great many interesting topics were secured which may properly be termed accessories. A Leeds, England, firm will install in connection with Machinery Hall a plant for turning out briquettes. The capacity will be about 50 tons a day. Still another firm undertakes to put in aplant for destroying garbage. Lieutenant Carden inspected one of these refuse plants in Leeds and he reports that the Leeds municipality derives a revenue over and above all expenses of maintenance and repair.

At the Paris Exposition the total pumping capacity demanded was about 4500 gallons per minute. At St. Louis 90,000 gallons per minute is the load imposed. The intramural railway of the Exposition consists of a double-track trolley road seven miles in length and the power for operating this railway system will come from the main floor of Machinery Hall. The elements which will be availed of will be taken from points as far apart as San Franciso and Berlin. Five prime movers will be employed., including three steam engines of American make, a gas engine from Berlin and a Tangential water wheel from San Francisco. The San Francisco water wheel is ordinarily used in connection with a small volume of water having a very great fall. The eqivalent of 1000-foot head will be given the wheel by availing of water pumped under very high pressure through a small nozzle. The wheel will be directly connected to a generator and a development of 1000-h.p. is called for. It is proposed to incase the wheel in glass, and it is said that the shape of the buckets on the wheel is such that the water falls from the same as softly as if poured from a dipper. The wheel will be turned at the rate of 900 revolutions per minute.

The Horse Power

The use of the "horse-power" as a measure of an engine's work came naturally from the fact that the first engines were built to do work which had formerly been performed by horses. John Smeaton, who built atmospheric engines before Bolton & Watt placed their more complete machines upon the market, had valued the work done by a strong horse as equal to lifting a weight of 20,000 pounds one foot high in a minute. When Bolton & Watt began to bid for public favor, they agreed to place their engines "for the value of one-third part of the coal saved in their use." They also increased the value of the "horse-power" to 33,000 foot pounds, so that their engines were half again as powerful for their rated power as those of their competitors. In this way they established the value of the horse-power.

The following are the values of a horse power

33,000 foot pounds per minute.
550 foot pounds per second.
2,565 thermal units per hour.
42.75 thermal units per minute.

The horse power of a boiler depends on its capacity for evaporation. The evaporation of 30 lbs. of water from 100 degrees F. into steam at 70 lbs. gauge pressure equals 30½ lbs. from, and at 212 degrees F. is equal to a horse-power.

The amount of water which a boiler will evaporate at an economical rate, in an hour, divided by the above quantities, is its commercial horse-power.

A unit of evaporation is the heat required to raise a pound of water from and at 212 degrees—966.1 thermal units.

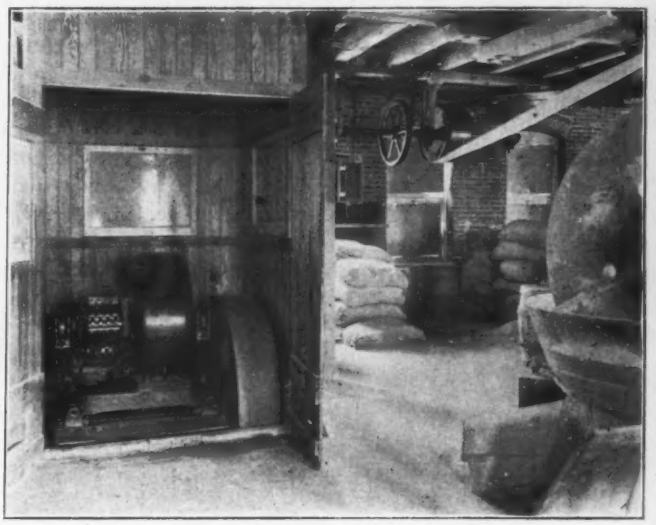
A thermal unit is the amount of heat required to raise a pound of water one Fahrenheit degree in temperature at its point of maximum density.

Power Plant of the Patton Paint Company, Newark, N. J.

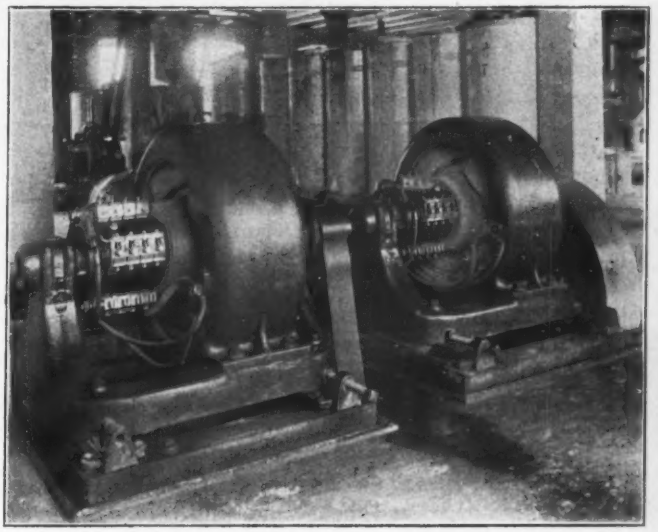
In the new works of the Patton Paint Company, recently erected at Newark, N. J., to supply the eastern trade with its "Sun-proof" paints, may be seen one of the most modern paint factories ever built. The exterior view of buildings given indicates many desirable features in arrangement and location, among them the obvious endeavor to isolate the different departments as far as possible without sacrificing convenience in the handling of materials, so as to hinder the spreading of a fire from any one section to another. Directly behind the works flows the Passaic River, unfortunately fit to be used only for condensing the exhaust from the engines, while on the near side are the tracks of the Erie Railroad offering good shipping facilities. The five-story building with the tower is the paint factory proper; the low building at the left accomodates the shipping and storage departments, and the building at the centre in the rear may be readily recognized by the chimney stack as the power plant. To this building and its contents the first part of this description will be confined and following that some mention will be made of the motors and the more important among the power users in the main building.

Exterior of Patton Paint Works

The boiler room is separated from the engine room by a fire wall and contains two Coatesville return tubular boilers, 6 feet in diameter by 18 feet long. The heating surface in each boiler is 1,829 square feet, the grate area 40 square feet, the steam pressure carried is 150 pounds and the capacity of each is between 175 and 200 boiler h.p. A 48-inch smoke header receives the gases of combustion and conveys them to a chimney 80 feet high and 4 feet in diameter on the inside. In the smoke connection before it enters the stack, is placed a Locke damper regulator for increasing or decreasing the draft when the steam pressure falls or rises. From the boilers an 8-inch steam main leads through the dividing wall into the engine room and connects to a 12 and 24 x 36-inch Hewes & Phillips horizontal cross-compound Corliss engine, which runs at 125 revolutions per minute and drives by direct-connection a 125-kilowatt 250-volt Crocker-Wheeler direct-current generator. Steam is supplied to the high pressure cylinder at full boiler-pressure through a 4-inch 180-degree bend starting from the upper side of the main and ending in a steam separator directly over the admission valve, and is exhausted at about 8 pounds pressure to the low-pressure cylinder through an intermediate receiver, located under the floor. From the latter it is finally exhausted through a Berryman closed-type feed-water heater into a condenser. Floor space and arrangements for future piping connections have been left to allow for the installing of another engine-generator unit of the same apparatus and size when, with the anticipated growth of the business, the load becomes large enough to require it. In the meantime it is so provided that if the load exceeds the capacity which the engine has when running in its normal manner, the high-pressure cylinder may be caused to exhaust to the atmosphere and the low-pressure cylinder may be supplied directly with live steam reduced to at least 80 pounds for the sake of safety, or still lower, depending upon the amount of the overload. The compound engine may thus be resolved into two simple engines. This is perfectly allowable, as the generator is abundantly capable of carrying a much greater overload than the engine under regular conditions of operation is designed for.



Crocker-Wheeler motors for driving line shafting



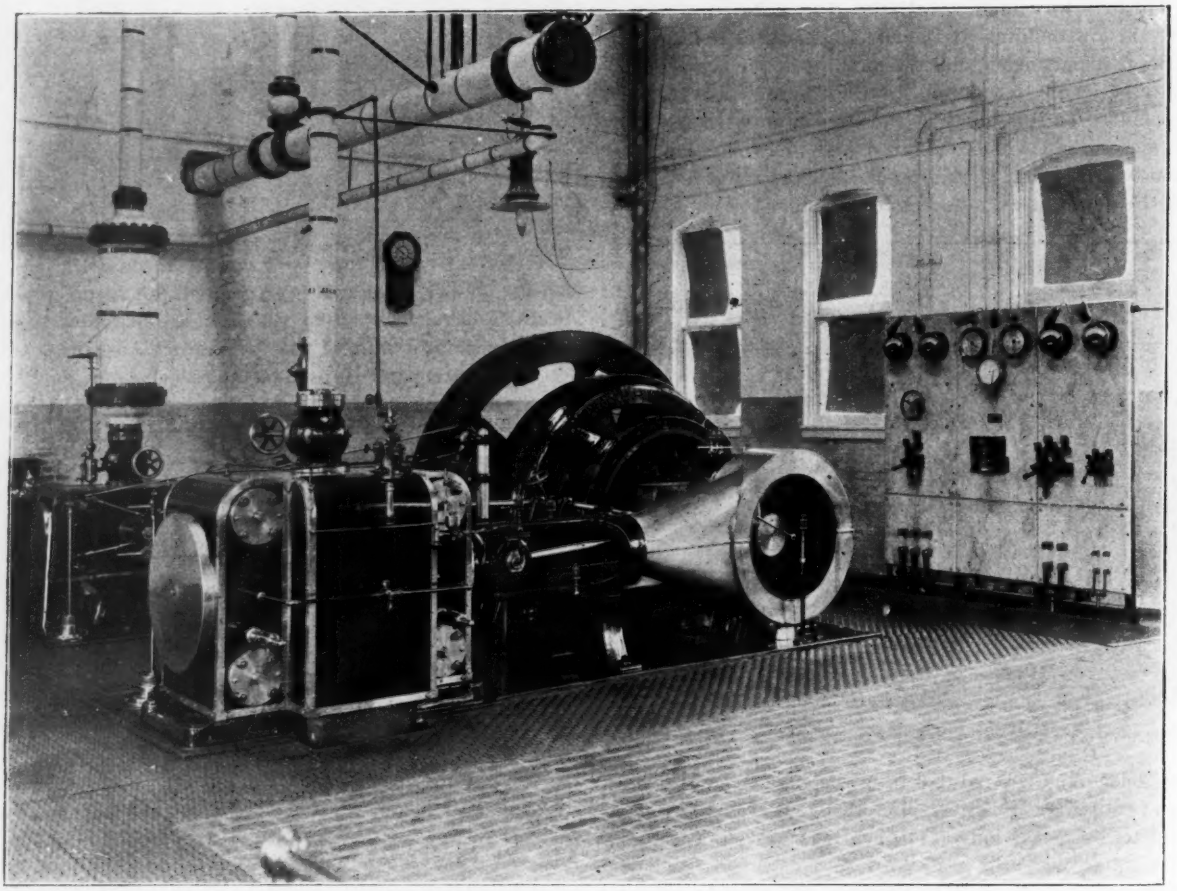
Ten horse-power motors for driving individual machine

In the winter or whenever steam-heating must be supplied to the building, the condensers are cut out and the exhaust

steam at about 2 pounds is turned into the heating system. The steam before going to the radiators is required to pass through an open-type feed-water heater, and the excess may be exhausted to the atmosphere through a vertical 12-inch riser containing a back-pressure valve. During the season when the exhaust steam is thus utilized it is first passed through an oil extractor. Direct radiation is used exclusively for the heating and includes a total in pipe coils and cast iron radiators of about 3,380 square feet of radiating surface. The steam is supplied by what is known as the Van Auken vacuum system, and the temperature regulation is accomplished by the use of Belvac thermofiers.

The returns from the heating system and all condensation

tributing panels, respectively. The generator panel contains a volt meter, an ammeter, a field-regulating rheostat, a single-pole circuit-breaker in one of the dynamo leads, and a three-pole switch for connecting it with the bus-bars on the rear of the board. The station panel contains a steam gauge on the high-pressure supply, a duplex gauge on the receiver between the engine cylinders, a recording volt-meter and an integrating watt-meter. The distributing panel contains an ammeter, a double-pole circuit-breaker, a two-pole switch for connecting the power feeders with the bus-bars and a similar set of smaller capacity for the lighting system. Eventually when the second engine is installed the board will be extended by the addition at the ends of duplicate generator and distributing panels.



Showing Hewes & Philips Cross Compound Corliss type engine and Switchboard

free from grease pollution is used repeatedly. A 10 x 14-inch Burnham simplex vacuum pump drains the heating system to a return tank and the high-pressure drips are relieved through steam traps. Finally the accumulation is passed through the open feed-water heater to the boilers by two 5¼ x 3½ x 5-inch feed pumps.

The electric current is generated at 250 volts and supplies an average load of 475 amperes divided among eighteen motors, ranging in size from 1 to 35 h.p. and aggregating 366 h.p.; 17 arc lights, and 200 incandescent lamps. After working hours the engine is stopped and the incandescent lighting is thrown onto the city alternating current service for the night.

The switchboard is very clearly shown in one of the accompanying cuts. At present it consists of three panels, which from left to right are identified as generator, station and dis-

In the main factory building wherever line shafting is used it is driven through a Renold "silent" chain by a Crocker-Wheeler motor on the floor above. On the fifth floor there are two motors, one of 35 and one of 15 h.p., each of which drives a lead chaser. These are pieces of apparatus in which white lead, the foundation for all of a certain class of paints, is worked and freed of its contained moisture. On the fourth floor there are two 35 h.p. and one 20 h.p. motors driving shafting on the floor below. An accompanying cut shows one of the two larger motors and the manner in which they are housed to protect them from the powdered white lead and dust which is very apt to be floating in the air. The third floor has a pair of similar 35 h.p. motors and one 10 h.p. motor all driving through the floor with chain connections. These motors are not enclosed, but sheet iron casings cover the chains and sprocket. Another

cut shows the two 35 h.p. motors at close range with one of the casings removed exposing the chain. It is interesting to add that, at the time the picture was taken the motors were running at 800 revolutions per minute and, although a time exposure was made the rotating parts are the only ones that are blurred, indicating how very slight was the vibration. On the second floor there are two 10 h.p. motors driving paint mixers on the first floor, and three 15 h.p. semi-enclosed Crocker-Wheeler motors direct-geared to so-called "Giraffe" mills in which the white lead receives its final grinding.

In the cellar there are four motors, one of 12 h.p. operates a slow-speed freight elevator which was installed by the Morse-Williams Company. At each floor the elevator shaft is provided with an automatic gate which rises and falls as the car passes that floor, being fully open only when the bottom of the car is exactly at the floor level. A 7 h.p. motor running at 1,100 revolutions drives a $7\frac{1}{2}$ x 4-inch air compressor, giving it a capacity of 35 cubic feet of air per minute. The compressed air is used to blow dust out of motor armatures, etc., and is drawn from a storage tank in which the pressure is maintained at a constant value by the action of the air on an automatic switch. A 2 h.p. motor is belted to a $2\frac{3}{4}$ x 3-inch duplex water-circulating pump, and a 3 h.p. motor is geared to a triplex oil pump. The latter is used in connection with an especially interesting system for handling the various kinds of oil used in the manufacture of paint. In the first place the oil is received at the plant in tank cars and is pumped therefrom to the one of the several storage tanks in which its kind is kept. The triplex bump is arranged with proper pipe connections and valves to make this selective distribution possible. For instance, if it is raw linseed oil that the car contains, it is passed to a certain 60,000 gallon tank in the yard, or if it is refined linseed oil it goes to another 60,000 gallon tank. Similarly if it be turpentine it is delivered into one or the other of two tanks provided for those liquids.

Hooper & Company, of Newark, N. J., were the architects for the buildings, and Mr. William R. Siegle, now chief engineer of the plant, superintended the installation of the mechanical and electrical features. The Bailey Company, of Milwaukee, installed the heating system; the Crocker-Wheeler Company the generators and all but a few of the smaller motors.

The Proper Conception of Belting.

Although there is not nearly as much known in general about the power of transmitting agencies as there should be, still it seems that almost any other method or means is better understood than belts. One of the chief difficulties in the way of a better knowledge of the belting problem, is the relations that belts and pulleys bear to each other. The general supposition, and one that leads to many errors, is that the larger in diameter the pulley is, the greater its holding capacity—the belt will not slip so easily, is the belief. But it is merely a belief, and has nothing to sustain it unless it be faith, and faith without work is an uncertain factor. I would like here to impress upon the minds of all interested the following immutable principles or laws:

1. The adhesion of the belt to the pulley is the same, the arc or number of degrees of contact, aggregate tension or weight being the same, without reference to width of belt or diameter of pulley.

2. A belt will slip just as readily on a pulley 4′ in diameter as it will on a pulley 2′ in diameter, provided the conditions of the faces of the pulleys, the arc of contact, the tension and the number of feet the belts travel per minute are the same in both cases.

3. A belt of a given width, and making 2,000 or any other given number of feet per minute, will transmit as much power running on pulleys 4′ in diameter, providing the arc of contact, tension and conditions of pulley faces all be the same in both cases.

It must be remembered, in reference to the first rule, that when speaking of tension, that aggregate tension is never meant unless so specified. A belt 6″ wide, with the same tension, or as taut as a belt 1″ wide, would have six times the aggregate tension of the 1″ belt. Or it would take six times the force to slip the 6″ belt as it would the 1″. I prefer to make the readers of this practical students. I want them to learn for themselves. Information obtained in that way is far more valuable, and liable to last much longer. In order that the reader may more fully understand whether or not a large pulley will hold better than a small one, let him provide a short, stout shaft, say 3 or 4′ long and 2″ in diameter. To this shaft firmly fasten a pulley, say 12″ in diameter, or any other size small enough that may be convenient. The shaft must then be raised a few feet from the floor and firmly fastened, either in vices or by some other means, so that it will not turn. It would be better, of course, to have a smooth-faced iron pulley, as such are most generally used. So far as the experiment is concerned, it would make no difference what kind of a pulley was used, provided all the pulleys experimented with be of the same kind, and have the same kind of face finish. When the shaft and pulleys are fixed in place, procure a new leather belt and throw it over the pulley. To one end of the belt attach a weight, equal say to forty pounds, or heavier, if desired, for each inch in width of belt used; let the weight rest on the floor. To the other end of the belt attach another weight, and keep adding to it until the belt slips and raises the first weight from the floor. After the experimenter is satisfied with playing with the 12″ pulley, he can take it off the shaft and put on a 23″,a 36″, or any other size he may wish, or, what is better, he can have all on the same shaft at the same time. The belt can then be thrown over the large pulley, and the experiment repeated. It will then be found, if the pulley faces are alike, that the weight which slipped the belt on the small pulley will also slip it on the large one. The method shows the adhesion of a belt with 180° contact, but as the contact varies greatly in practice, it is well enough to understand what may be accomplished with other arcs of contact. But, after all, many are probably at a loss how to account for some observations previously made. They have noticed that when a belt at actual work slipped, an increase in the size (diameter) of the pulleys always remedied the difficulty and prevented the slipping. A belt has been known to refuse to do the work allotted to it, and continue to slip over pulleys 2′ in diameter, but from the moment the pulleys were changed to 3′ in diameter there was no further trouble. These observed facts seem to be at variance with and to contradict the results of the experiments that have been made. All, however, may rest assured that it is only apparent, not real. The resistance to slipping is simply a unit of useful effect, or that which can be converted into useful effect. The magnitude of the unit is in proportion

to the tension of the belt. The sum total of useful effect depends upon the number of times the unit is multiplied. A belt 6″ wide and having a tension equal to forty pounds per inch in width, and travelling at the rate of 1′ per minute, will raise a weight of 240 pounds 1′ high per minute. If the speed of the belt be increased to 136.5′ per minute, it will raise a weight of 33,000 lbs. per minute, or be transmitting one horse-power. The unit of power transmitted by a belt is rather more than its tension, but to take it at its measured tension is at all times safe, and forty to forty-five pounds of a continuous working strain is as much, perhaps, as a single belt should be subjected to. A little reflection will now convince the reader that a belt transmits power in proportion to its lineal speed, Without reference to the diameter of the pulleys. Having arrived at that conclusion, it is then easy to understand why it is that a belt working over a 36″ pulley will do its work easy, when it refused to do it and slipped on 24″ pulleys. If the belt travelled 800′ per minute on the 24″ pulleys, on the 36″ pulleys it would travel 1,200′, thus giving it onehalf more transmitting power, if in the first instance it was able to transmit but eight horse-power, in the second instance it will transmit twelve horse-power. All of which is due to the increase in the speed of the belt and not to the increase in the size of the pulleys; because, as has been shown, the co-efficient of friction or resistance to slippage, is the same on all pulleys with the same arc of belt contact. There is no occasion for elaborate and perplexing formulas and intricate rules. They serve no useful purpose, but tend only to mystify and puzzle the brain of all who are not familiar with the higher branches of mathematics; and it is the fewest number of our every-day practical mechanics who are so familiar. In all, or nearly all treatises on belting, the writer will tell you that at 600, 800 or 1000′ per minute, as the case may be, a belt 1″ wide will transmit one horse-power and yet when we come to apply their rules to practice, no such results can be obtained one time in ten. The rules are just as liable to make the belt travel 400, 1000 or 1600 per minute per horse-power, as the number of feet they may give as indicating a horse-power. I have adopted, and all my calculations are based upon the assumption that a belt travelling 800′ per minute, and running over pulleys both of which are the same diameter, will easily transmit one horse-power for each inch in width of belt. A belt under such circumstances would have 180° of contact on both pulleys without the interposition of idlers or tighteners. The last proposition being accepted as true, and the basis correct, the whole matter resolves itself into a very simple problem, so far as a belt with 180° contact is concerned. It is simply this: If a belt travelling 800′ per minute transmit one horse-power at 1,600′, it will transmit two horse-power, or, if 2,400′, three horse-power, and so on. It is no trouble for anyone to understand that, if he understands simple multiplication and division. It is not, however, always the case that both pulleys are the same size; and as soon as the relative sizes of the pulleys change, the transmitting power of the belt changes, and that is the reason why no general rule has ever or ever will be made for ascertaining the transmitting capacity of belts under all circumstances. When the pulleys differ in size, the larger of the two is lost sight of—it no longer figures in the calculations—the small pulley only must be considered. To get at it, the number of degrees of belt contact on the small pulley must be ascertained as nearly as possible, and used for a guide for getting at the transmitting power, the next established basis below. Of course the experimenter can make a rule for every degree of variation; but it would require a great many, and it is not necessary. I use five divisions, as follows:

For	180°	useful	effect	1.00
"	157½°	"	"	.92
"	135°	"	"	.84
"	112½°	"	"	.76
"	90°	"	"	.64

The experimenters will find that my figures are under-obtained results, which is exactly what they are intended to be, more especially at the 90° basis. I wish to make ample allowance. To ascertain the power a belt will transmit under the first-named conditions, divide the speed of the belt in feet per minute by 800, multiply its width in inches and by 100. For the second, divide by 800, multiply by width in inches and by .92. Third place, divide by 800, multiply by width in inches and by .84. Fourth place, divide by 800, multiply by width in inches and by .76. Fifth place, divide by 800, multiply by width in inches and by .64. As an example: What would be the transmitting power of a 16″ belt, travelling 2,500′ per minute by each of the above rules?

1st.	2500÷800=3.125 x 16	and	1.00	= 50 h. p.
2nd.	2500÷800=3.125 x 16	and	.92	= 46 h. p.
3rd.	2500÷800=3.125 x 16	and	.84	= 42 h. p.
4th.	2500÷800=3.125 x 16	and	.76	= 38 h. p.
5th	2500÷800=3.125 x 16	and	.64	= 32 h. p.

As I have said, if the degrees of contact come between the divisions named above, in order to be on the safe side calculate from the first rule below it, or make an approximate, as they like. If the above lesson is studied well and strictly used, there can be no excuse for any mechanic putting in a belt too small for the work it has to do, provided he knows how much there is to do, which he ought, somewhere near at least.

The Conditions of Steam Generation.

According to the current hypothesis on the constitution of matter, a very essential difference between the liquid and gaseous states of matter is that, in passing from the first to the second, the constituent molecules of the substance are forced further apart. This seems to explain the fact that, when a liquid passes into gas, it not only "evaporates" and disappears, but also fills a very much larger cubic space. Moreover, the amount of this expansion—as measured by the cubic content filled by the gas, as compared with that filled by the liquid—is in proportion to the heat under the action of which the water is vaporized. If then, a gas subjected to heat be confined in some receptacle, so that it connot occupy the space properly belonging to it, it will show its tendency to assume that volume by exerting a pressure in proportion to the temperature in the receptacle. This is precisely what happens in a steam boiler. The steam when liberated from confinement, will continue to exert a constantly decreasing pressure until it has reached the volume properly resulting from its temperature, at which point the pressure will be that of the atmospheric air. It is this pressure, or natural effort to assume a greater volume—hence to displace movable

obstacles—that is employed in the steam engine for producing motion and transmitting power.

In dealing with the general problems of steam engine operation, we must recognize two kinds of steam, or rather two conditions in which it is found and used. The first is that known as "saturated" steam, which may be defined as steam in contact with the water from which it has been generated, and which has absorbed and holds, as "latent heat," the full number of the thermal units necessary to completely vaporize the liquid at the given pressure. The significance of the word "saturated" is thus apparent—the steam holds in solution the full quantity of heat theoretically needed to produce and maintain it as steam. The second distinction of steam is "separated" steam, which signifies steam mechanically separated from the generating liquid, so that, when fed to the cylinder of the engine, it is perfectly dry. As the process of separating properly involves the constant maintenance of a high temperature, so that the process of condensation may be prevented, the dry steam continues to absorb heat, above the point required for this end, and thus becomes what is known as " superheated "steam.

When steam is properly separated and superheated, its expansion and other properties, so long as the initial temperature is maintained, follows closely on the laws governing the actions of permanent gases. This is true only in a limited sense of steam that is still in contact with the generating liquid; since, not only does increase of heat within the generator or boiler, tend to continue the process of steam production within small limits, but also because the steam holds in suspension a certain amount of unvaporized liquid particles. From either or both these causes, its co-efficient of expansion is larger than that of dry steam. That is to say, it undergoes a greater increase potential volume, as indicated by the consequent rapid proportionate increase in pressure, within the generator, or heated receptacle. Another point of difference—here it is that dry steam assumes the general properties of permanent gases—is that saturated steam, when a certain high point of pressure has been reached, tends to liquefy; hence also preventing the heated water from giving off any more vapor. Dry steam may not be condensed by pressure, so long as the temperature is not lowered. On account of this law of pressures, the evaporation of water by the sun, under atmospheric conditions, is less rapid than at high temperatures; also, water enclosed in a vacuum tube, where it is subjected to no pressure, theoretically may be boiled, producing vapor at the temperature of the human body (96° Fahrenheit).

Noon Hour at Powers' Mill

Part 4.

By A. Edward Rhodes.

Say kid, you know that there screw press over in the hydraulic room, if you rec'lect, the screw is driven directly by a pully and belt. Mr. P. was a talkin' to me this mornin' about buildin' a larger size, in which greater pressure with the same pitch of screw and the same number of turns per minnit is required. He asked my advice as to whether it would be better to increase the width of machine pulley and belt, or increase the diameter of the pulley on the screw, and keepin' the 'riginal width of belt. I adwised him to persue the latter course. My reasonin' was that, in putting a wider belt on the 'riginal diameter of the pulley, we could only gain because of the increased strength of the belt allowin' of us to make her tighter. I said to Mr. P., says I, in other words, the increased width of bearin' in the pulley won't increase its stickin' power (adhesion). The narrow belt would pull jist as much with out slip, pervided it could stand the same amount of pullin' (tension), as the wider belt. In course the weight of the wider belt would count for sumpin if it were not fur the fact that the screw pulley must be driven by a vertical belt. I says to Mr. P., says I, as I understand this case, by us a usin' a larger diameter of pulley insted of a wider one we would gain (not power), in several ways; first, there would be an increase in leverage; second, we would gain because of the necessary increase in the velocity of the belt; and lastly, there would be less friction on the shaft than if a wider belt (cause a wider belt must be tighter), were used. Now you have a been a blowin' about your book learnin' an I don't claim to have any, but I bet I am right on that the narrow belt is the best.

Well Dick, I must acknowledge that for once you are right, and that I believe your reasoning is correct and very good. By increasing the diameter of the pulley, and not changing the number of revolutions of the screw you increase the speed of the belt, and although by this increase of diameter of pulley you do not gain any power, you certainly increase the capability of the belt to transmit power, consequently, since the screw press Mr. Powers wishes to build will require greater power to run it, the increased power required to drive it can be transmitted through the narrow belt passing over a pulley of increased diameter. * * * * * * * *

Talking about that press in the hydraulic room reminds me to ask in regards the velocity of water in pipes, and the quantity discharged in a given time?

Vell now, it vas in dis vater question dot I vas some experts. Listens und I oxblains, we vill take the following oxample to make it clear to your intelligences. The steam cylinder of der dublex bump at der brewery is 14 inches dimeter; der vater plunger is 4 inches dimeter; steam bressure is a hunered und den bounds per square inch; und she makes 130 strokes to der minnit. She is connected to a bress whose blunger 12 inches dimeter, und vill raise 3 feet. Der pipe dot connects der bump to der bress is 2 inches dimeter und 23 feet long. I claims to Dennis dot if ve put in a 2½-inches dimeter pipe insted of dot 2-inch pipe vot now is in, der velocity will be reduced, but der blunger of der bress vill go up faster. Dennis says no, und dot I vas a Dutchmans und can't help bein' a vool, und dot blunger vill not go up so fast by der change, on account of makin' der velocity reduced.

Hans as usual, both you and Dennis are wrong. The speed of the plunger in the press does not depend upon the diameter of the pipe which connects the press to the pump, but it depends upon the speed and diameter of the water plunger in the pump; and so long as the diameter and speed of this water plunger remain the same, the speed of the plunger in the press will also remain the same. Making the diameter of the pipe, which connects the pump and press, larger or smaller, will decrease or increase the friction in the pipe, and consequently the power necessary to work the press will be decreased or increased by changing the diameter of the pipe.

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Compounding a Steam Engine

What is to the minds of some engineers a very complex question is after all a very easily understood problem—namely the compounding of a steam engine. With the names cross-compound, quadruple expansion, tandem compound and the like appelations, raises up in the mind a multiplicity of mechanical devices, ponderous machinery and complex valves, yet the compound engine is easily analyzed as will be observed.

A compound engine is one in which the steam is used several times over in as many separate cylinders, although usually applied to engines operating with two cylinders. The steam is fed from the boiler direct to the first cylinder in which it is cut off late in stroke, in order that its pressure may be utilized to the greatest possible extent. The exhaust from this cylinder is then fed into the second cylinder, generally two or three times the cubic contents of the first, and is worked expansively to a point as near atmospheric pressure as possible. The most practical and efficient application of this principle is in the triple and quadruple expansion engines, so largely used in marine work, which, in connection with the vacuum-producing condenser, allows the steam to be worked from the highest available pressure down to practical zero. There are two common forms of compound engines of two or three cylinders, which from the arrangements of the working parts, are known as "tandem compound" and cross compound. In the tandem compound engine the cylinders are placed end to end, the several pistons operating one piston rod. In the cross compound engine the cylinders are placed side by side, the two or more piston rods operating on a single crank-shaft.

A Disputed Boiler Setting

Most frequently in the setting of the ordinary return tubular boiler the chimney is placed at the rear of the boiler, or behind the battery of boilers. The gases of combustion are discharged from the boiler tudes at the front. To convey them to the chimney, then, either of two methods may be used. The more common is to run a sheet-iron flue from the smoke box to the chimney. Another method, which is to be found in numerous instances, is to carry the products of combustion back over the top of the shell and discharge them into the chimney or the flue at that point.

The latter is accomplished by the building a brick arch over the top of the boiler from end to end. This arch is supported by the side walls of the setting and it is kept from sagging and springing the walls apart by means of the buckstaves and tie rods which bind the walls together at top and bottom.

Through the space thus formed between the arch and the top of the boiler shell, the hot gases are led from the smoke box to the flue at the rear. Such an arrangement is claimed to possess a double advantage as a heat saver.

In the first place, it is claimed that the heat in these gases tends to superheat the steam in the steam space, since there is only the thickness of the boiler plate between the flue gases and the steam. In the ordinary boiler the flue gases have a temperature of 500° F. or thereabouts as they are discharged, and consequently it would seem that such a temperature would be able to do considerable superheating of the steam.

The second advantage claimed for this type of setting is that it reduces the radiation loss from the top of the boiler. As is well known, there is a continual dissipation of heat from the boiler by radiation through the settings, fronts and the coverings, no matter how much care is taken to prevent the same. The layer of hot gases along the upper surface of the shell, hotter than the steam within, will of course prevent the steam from losing any heat and thus condensing to any extent.

The second of these claims cannot be refuted. It is undoubtedly true that the hot gases will give up their own heat instead of permitting the steam to part with some of its heat. And since the heat in these gases would but go to the chimney in any case, the saving of the radiation from the top of the boiler is a net gain.

However, the first advantage is by no means so certain. No matter what the character of the coal used there will always be a certain amount of dust and cinders entrained with the flue gases. In the setting described, it will not take very long for the top of the boiler shell to become covered with a layer of soot and dust. This forms a practically non-conducting covering for the shell, and hence no matter how much heat may have been transmitted to the steam from the flue gases when the plate was clean, little or none will be transmitted after the deposit of soot has once formed.

The collection of ashes and dust on the sheet to any considerable extent may of course be obviated by frequent cleaning. But this is not a particularly pleasant task, and it is doubtful whether the gain in efficiency is compensated for by the increased cost and trouble.

For such a setting does increase the cost of erection. The building of the arch is an additional feature and is not an easy one, either. In the ordinary setting, the top of the boiler is covered with removable sections of some non-conducting substance to prevent any great radiation loss. This is less expensive than the building of a brick arch, and it is very effective in preventing radiation.

Furthermore, the removable sections are more convenient in case the boiler is to be inspected externally. For the top of the shell can be quickly uncovered and the seams and shell easily examined for leaks or corrosion. With the brick arch such an inspection is almost impossible unless the arch is sufficiently high for a man to crawl between it and the shell.

Many return tubular boilers are built with domes, though the use of the dome is growing less. To make an opening in the arch for the dome, and to keep a tight joint, free from air leaks, is no easy matter, especially when it is noted that the expansion and contraction of the shell has a tendency to develop cracks in the arch and throw down the brickwork.

A Few Figures on Pipe Covering

Almost anyone connected with a steam plant recognizes the fact that there is considerable loss of heat through radiation from uncovered pipes, but it is equally true that there are a great number of steam plants in which pipe covering is unknown. Now if we look into this subject in a comprehensive manner we shall find that pipe covering is one of the least costly, and largest dividend paying investments in the whole plant.

With reference to the economy and cost of non-conducting material, it may be said that the material which is in the greatest degree non-conducting, incombustible and durable, will prove the most economical, even though its first cost be greater than that of an inforior article. Experiments with naked pipes show that 2′ pipe carrying steam at 60 lbs. pressure will condense 180 grammes per foot per hour. Covering with the best non-conducting covering the condensation will be 36 grammes per foot per hour, a saving of 144 grammes per foot per hour, which is equivalent to 3 lbs. of water per day of ten hours for each foot of pipe covered. The covering of 100′ of pipe will then save, in a year of 300 ten-hour days, the coal necessary to convert 90,000 lbs. of water into steam. One pound of bituminous coal is capable of converting about 8.5 lbs. of water into steam, so that the saving in coal due to 100 feet of covering would be 10,588 lbs. of coal, which at $4.00 per ton amounts to $21.16 The real saving would probably be more than this. It may be stated in round terms that 100′ of covering causes each year a saving in fuel of its own first cost. Inasmuch as the best non-conducting covering pays for itself in one year, and will last indefinately under ordinary circumstances, its efficiency is beyond question.

The Value of Accuracy in the Steam Gauge

A great many employers of engineers have but little faith in the judgment of their men when it comes to the purchase of supplies, usually thinking that they know as much as the engineer about such things. That they are far wrong can be shown in numerous instances, particularly is this true in the matter of mechanical equipment, for instance the engineer may ask for a new steam gauge, knowing the old one to be inaccurate, the employer will look at it and can see nothing wrong and will think the old one good enough. Now let us analyze the steam gauge and we will find, simple as it looks, that there is considerable depending upon it beside safety.

The object of the steam gauge is to indicate the steam pressure in the boiler, in order that it may not be increased far above that at which the boiler was originaly considered safe; and it is as a provision against this contingency that a really good gauge is a necessity where steam is employed, for no guide at all is vastly better than a false one. The most essential requisites of a good steam gauge are, that it be accurately graduated, and that the material and workmanship be such that no sensible deterioration may take place in the course of its ordinary use. The pecuniary loss arising from any considerable fluctuation of the pressure of steam has never been properly considered by the proprietors of engines. If steam be carried too high, the surplus will escape through the safety-valve, and all the fuel consumed to produce such excess is so much dead loss. On the other hand, if there be at any time too little steam, the engine will run too slow, and every lathe, loom, or other machine driven by it, will lose its speed and, of course, its effective power in the same proportion. A loss of one revolution in ten at once reduces the productive power of every machine driven by the engine ten per cent., and loses to the proprietor ten per cent. of the time of every workman employed to manage such machine. In short, the loss of one revolution in ten dimishes the productive capacity of the whole concern ten per cent., so long as such reduced rate continues; while the expense of conducting the shop (rent, wages, insurance, etc.,) all run on as if everything was in full motion. A variation to this amount is a matter of frequent occurrence, and is, indeed, unavoidable, unless the engineer is afforded facilities to prevent it. A very little reflection will satisfy any one that it must be a very small concern, indeed, in which a half hour's continuance of it would not produce a result more than enough to defray the cost of a very expensive instrument to prevent it. If the engineer, to avoid this loss, keeps a surplus of steam constantly on hand, he is wasting the steam, consequently fuel, thus incurring another loss, which, though less alarming than the first, will yet be serious and render any instrument most desirable which can prevent it. It is, therefore, of great importance to the proprietors of engines to have an instrument which can constantly indicate the pressure in the steam-boilers with accuracy. This would enable the engineer to keep his steam at a constant pressure, thus avoiding the waste of fuel on the one hand, and the still more serious loss of the productive power of the shop on the other.

Steam Plant Valves.

Part I.

By R. T. Strohm

The boiler constitutes the first piece of apparatus in the series by which the chemical or latent heat of the fuel is transformed into work in the ordinary steam plant. In taking up a description of the types and uses of the valves in such a plant, then, it is natural and logical to begin with those which are attached to the fittings of the steam boiler.

After leaving the feedwater heater, or upon leaving the feed-pump, if there is no heater employed, the feed-water first passes through the check valve in the feed-pipe. The check valve serves to prevent the escape of water from the boiler through the feed-pipe after it has been once forced in by the pump. It allows the passage of the water in one direction, to the boiler, on the discharge stroke of the pump, but it closes quickly as soon as the flow toward the boiler ceases.

Check valves are of various types, but Figs. 1, 2, and 3 show the most common forms. That illustrated in Fig. 1 is perhaps more used than any of the others, and is known as a globe check. The valve disk is provided with wings below and guides above, which prevent its getting out of line and insure its proper seating.

The swing check valve is shown in Fig. 2. In this type the valve seat is inclined at an angle, and the valve disk is fastened to an arm which is pivoted at one end. This type of check has the advantage over the globe check in that it gives a more direct passage to the liquid flowing through it, thus lessening the frictional resistance. The pressure of the fluid column moving in the direction from right to left swings the disk outward and upward, and the liquid is scarcely changed in direction as it passes through. In the case of the globe check, the direction of flow is changed twice at right angles. To prevent

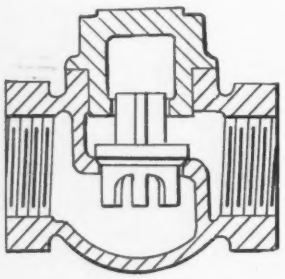


Fig. 1

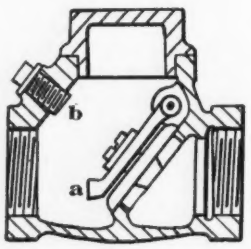


Fig. 2

the valve disk from swinging above a horizontal position, a boss *a* is formed on the end of the arm, which strikes against the adjustable screw *b*.

The third form of check valve, illustrated in Fig. 3, is called a ball check. The valve proper, in this case, consists of a metal sphere instead of the flat disk used in the other two types.

It is evident from the construction of these valves that they are intended to be used on horizontal pipes and not on vertical pipes. In cases where it becomes necessary to use a check on a vertical line different constructions of these general types must be made.

Having passed through the check valve, the feed-water is now forced through a globe valve which serves as a means of throttling the feed to the boiler or of cutting it off altogether, in case several boilers are fed from one main line.

The globe valve is illustrated in Figs. 4. 5, and 6. In Fig. 4 is shown the most common form of globe valve, as used on straight pipe lines. The fluid enters at the left and leaves at the right. The valve seat is formed by accurately facing the raised lip surrounding the opening in the partition wall. The valve disk is recessed, and in the groove is a ring of composition which fits down tightly upon the seat and forms a steam-tight joint. The disk may

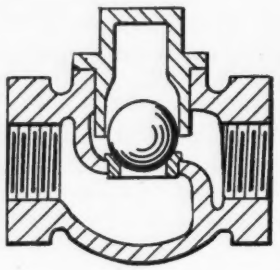


Fig. 3

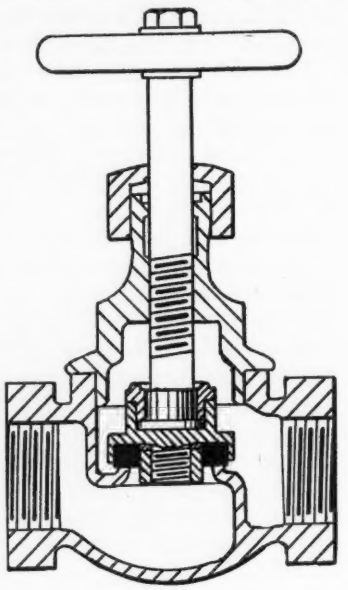


Fig. 4

be easily and quickly removed by taking off the valve bonnet, and the ring of composition renewed when it has become worn or crushed so as to fail to make a tight joint with the seat.

An angle globe valve is shown in Fig. 5. This differs from the one shown in Fig. 4 in that it is intended to regulate communication between two pipes meeting at right angles. Both the valve disk and the seat are beveled so as to form a tight joint. The end of the valve stem, also, is made spherical in order that the disk may be quite free to adjust itself properly to the seat. Obviously, this principle may be applied to any type of globe valve.

If the fluid passing through the valve contains grit of any kind, the valve disk will likely become so worn as to need occasional replacing to maintain a tight valve. In the types of valves shown, this would necessitate the removal of the bonnet and the stem, which could not be accomplished until all pressure had been shut off. This might be inconvenient under certain circumstances, and so the valve shown in Fig. 6 has been designed in order to permit the valve seat to be replaced while under pressure.

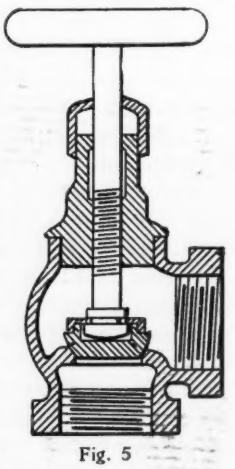


Fig. 5

As may be seen, the valve seat consists of a ring *a* held firmly in place by means of the collar *b* and the screw *c*. The valve disk *d* fits tightly against this ring when the valve is closed. By removing the screw cap *c* and at the same time screwing the valve disk *d* downward, the opening in the valve partition may be closed by the lug *e* on the disk. Then the collar and the seat ring may be taken out entirely, and the latter replaced, after which the parts may be replaced by reversing

the operations previously noted. In this valve, the pressure always comes on the top of the disk.

In those types of valves in which tightness is secured by frequent regrinding of the seats, it must be evident that a point will be reached at which further grinding will be impossible.

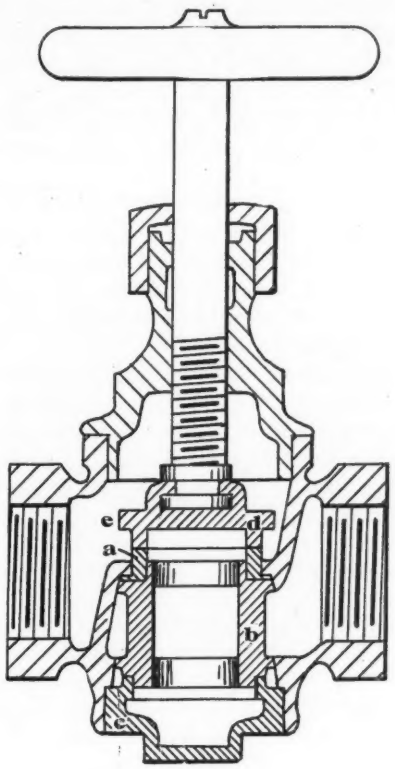


Fig. 6

The valve body is then practically useless. The wearing parts of the valve in Fig. 6, however, may be replaced again and again without detriment to the valve body.

Where a globe valve is subjected to high steam pressures it is frequently found difficult to maintain a tight joint between disk and seat. One method of insuring satisfaction in this particular is to construct the valve disk and the seat as in Fig. 7. The disk is made with a conical depression in its lower face. At the apex of this depression an annular groove is cut, extending around the circumference of the disk. The seat ring is made of a similar conical form, pointing upward, and contains a corresponding annular groove. When the disk and seat are pressed together, the contact surface is large, and the angle of inclination of these surfaces tends to force them into intimate contact. The groove gives a certain spring action to the lips *m* and *n*, and so the valve cannot be jammed by ordinary pressure. Further than this, changes of temperature will not affect the tightness of the valve, since the resilience of the disk and of the seat ring will compensate for any expansion or contraction.

There exists a considerable difference of opinion among engineers as to the relative location of the feed valve and the check valve. Some insist that the feed valve should be between the check valve and the boiler, and the others contend that the check valve should be the nearer to the boiler. It seems, however, that the better plan is to place a globe valve between the check valve and the boiler. The latter should be always in good working order. But it is subject to numerous conditions which may render it inoperative, or at least only partially so. A chip of scale or a bit of packing may lodge in the valve in such a way as to prevent its closing. In such a case, it becomes necessary to remove the valve bonnet and clean the valve.

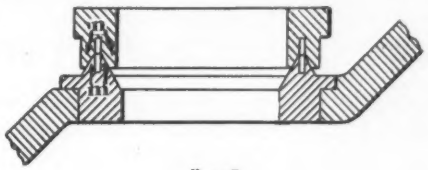


Fig. 7

Manifestly, this cannot be done while the boiler is under pressure, unless some stop is placed between the boiler and the check valve. Hence the desirability of using a globe valve, or feed valve as it is called, next the boiler.

Of course, the feed valve itself is liable to get out of order. It is used to throttle the feed and is subject to considerable wear. To repair it, it is necessary to shut down the boiler entirely. However, the check valve is the more liable of the two to cause trouble, and for that reason it is better to interpose the feed valve between the check and the boiler.

Another method which has found some favor is to use a second globe valve between the feed valve and the boiler. The purpose of this globe valve is to shut off the boiler pressure in case the feed valve needs to be repaired. As it is always kept wide open except at such times as the feed valve needs attention, the wear and tear upon it is slight and it will last for a considerable period. However, it increases the friction as well as the cost. Whether or not a stop valve is really essential between the check and the boiler will depend upon whether it is a serious inconvenience or not to draw the fires and relieve the boiler pressure in case the check valve becomes refractory.

The Study of Diagrams

The principal and most positive information to be derived from the reading of an actual indicator diagram is the measure of the force or pressure in the cylinder, acting upon the opposite sides of the piston, at any and all points, during one complete revolution of the engine; hence the actual card, as compared with the theoretical diagram, (under similar conditions) indicates the efficiency and economy of the engine; and all other information must be acquired through exceedingly careful consideration, and reasoning in the study of the diagrams, and conclusions arrived at therefrom in accordance with an exercise of the best judgment of the engineer.

The figures traced by the pencil will vary in outline in different engines, and also from the same engine under varying conditions, due to a number of causes; as leakage of valves, condensation and re-evaporation of the condensed steam in the cylinder, construction and the adjustment of valves, condition of the steam, etc.

These effects will be more apparent along the expansion curve especially; and as a consequence the actual curve will very rarely coincide exactly with the true theoretical curve.

Therefore it is very essential that all cards traced by the indicator should accurately represent the duty performed by the engine; as the accuracy of all such investigations depends entirely upon the correctness of the diagrams.

Upon an examination of the steam expansion curve of indicator diagrams it will be found (almost invariably) that the terminal pressure is relatively too high (from a given cut-off), as compared with the true theoretical curve; the amount increasing as the ratio of expansion increases; as shown in Fig. 1.

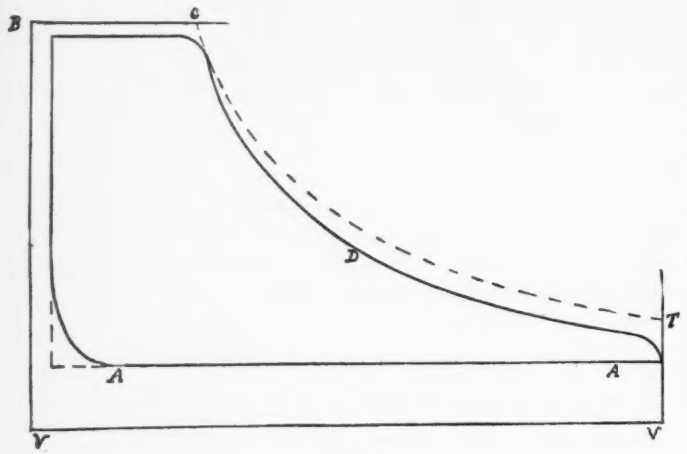


Fig. 1

This result may be due to either of two causes, or to both combined.

First. To leaky steam or admission valves, through which the steam is enabled to pass into the cylinder, after the closure of such valve; or, in other words, after the point at which cut-off is supposed to have taken place; and thereby producing a higher terminal than would otherwise appear with steam tight valves.

Second. To a re-evaporation of the entering steam that is condensed in the earlier part of the stroke, through coming in contact with the interior walls of the cylinder, which have been

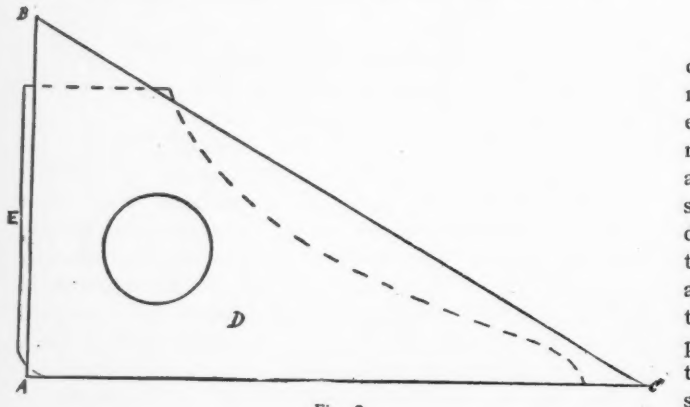


Fig. 2

cooled to a temperature corresponding to the lower pressure of the escaping steam, during its exhaust.

In some cases, however, the expansion curve of the actual diagram will be found falling below the true or theoretical curve throughout its entire length; as shown in Fig. 1, evidently due, to leaky piston and exhaust valves; this, also, in connection with exposed or unjacketed steam cylinders.

But it frequently happens that cards are found wherein the expansion curve coincides very nearly with the isothermal or theoretical, although they have been taken from the engines in which both valves and piston are known to leak badly.

In such cases the leakage through the admission valve after closing is just sufficient to restore the steam lost through a leaky piston, and the result under such circumstances are that the two curves will be a very near approach to each other.

Such cards from observation alone has the appearance of good efficiency and economy in the engine; when in fact the opposite of this prevails, and an extravagant waste and loss of steam is the consequence; all arising from a leaky condition of these parts.

The loss of steam from this cause, and also from cylinder condensation, is not accounted for by the indicator, hence does not appear in the diagrams, and is only made apparent by a comparison of the water consumption per horse power (as computed from the diagram), with the actual amount of water that has been supplied to the boiler.

An important matter to be ascertained in reference to all indicators, is, whether the vertical or admission line on the diagram, made by the pencil (when in contact with the paper on the drum) is exactly perpendicular to the atmospheric, or horizontal line, that is made by the pencil, when in contact with the drum while rotating.

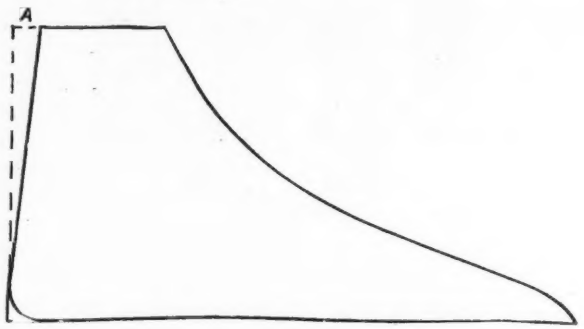


Fig. 3

A leaning of the admission line either forward or back, thereby causing it to be out of square with horizontal line, tends to be misleading in reference to the proper adjustment of the valves, especially if a fault of this kind exists in the instrument, and not previously known. This fact may be easily determined at any time before placing the spring in the instrument, by simply placing the paper upon the drum the same as for taking diagrams, and bring the pencil in contact with it; then cause the drum to rotate once back and forth by means of the cord attached to the indicator, thereby making a horizontal line on the paper; then mark a perpendicular to this by raising the pencil by hand to its extreme height. Remove the paper from the drum, and compare its correctness with any ordinary square or right angle triangle at hand, as shown in Fig. 2. Any inclination or leaning of the admission line in indicator diagrams, either forward or back, as in Fig. 3 and Fig. 4, is usually constructed and considered to be an improper anjustment of the valves.

For example: In reviewing the diagram represented in Fig. 3; from the fact of a leaning forward of the admission line, the time of opening of the valve for steam admission would ordinarily be assumed to be too late, or indicating insufficient

lead; and in consequence the piston has advanced a portion of the stroke, (as shown at A), before the initial pressure has reached its highest point; resulting, to a certain degree, in a loss of power and efficiency in the engine.

Again, suppose in a diagram the results are as represented in Fig. 4, where the admission line inclines outward; this might indicate either a too early opening of the steam vavle, thereby admitting steam in the cylinder before the piston had completed the stroke; or a too early closing of the exhaust at that end of the cylinder, thus causing excessive compression; either of which would also cause a loss of efficiency and power.

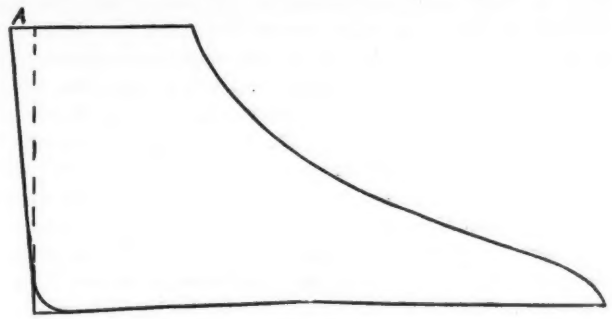


Fig. 4

Most types of indicators, after their being in use for a length of time, are liable to certain defects, or disarrangement more or less in their pencil movement (and these defects sometimes appear in new instruments), and which prevents the initial pressure or vertical line as traced upon the paper from being at a right angle or perpendicular to the atmospheric line; and in such case the instrument is usaully designated as out of square.

As a consequence, the admission line at either end of the diagram will be inclined to the perpendicular, as appears by the dotted lines A.A. in the diagrams Fig. 5, and which may

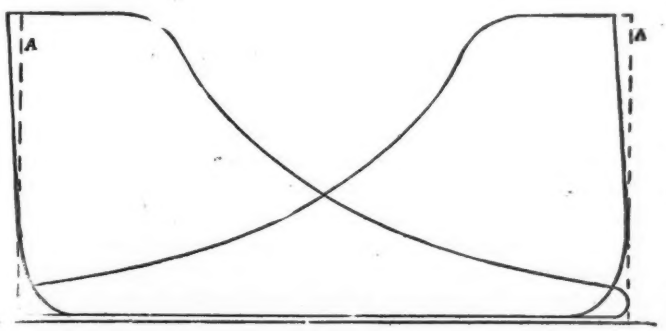


Fig. 5

be wholly due to such incorrectness in the indicator as stated; notwithstanding the valve adjustment of the engine may be practically all that can be desired.

This discrepancy very often arises from careless handling, and from culpable neglect and abuse of the instrument in various ways. Where a defect of this description exists in the instrument, it is generally advisable to send it at once to the maker, to insure that the necessary correction be properly and satisfactorily accomplished.

Natural Philosophy

Mechanical Properties of Bodies

Q. Illustrate the astonishing energy of attraction between atoms?

A. The strongest iron wire, of one quarter of an inch in thickness, could not be broken by the united strength of five horses.

Q. Illustrate the repulsion exerted between the atoms by the effect of heat?

A. The explosive force of gunpowder projects heavy cannon balls to great distances, and rends the hardest rocks into fragments.

Q. Have substances different mechanical properties?

A. They have; for example, iron is hard, chalk is soft, glass is brittle, and gold is malleable.

Q. Are there any other metals that can be hammered out into leaves, or rolled into sheets, besides gold.

A. Silver, lead, aluminum, tin, copper, zinc, platinum and iron are malleable.

Q. What is meant when it is said that a certain metal or other substance is ductile?

A. That it can be drawn out into a wire or thread.

Q. What metals are ductile?

A. Platinum, silver, iron, copper, and gold. Zinc, tin, and lead are also ductile in an inferior degree. Melted glass is very ductile and can be drawn out, or spun into fine threads.

Q. Why does a piece of India rubber when stretched fly back if left to itself.

A. Because the particles, when displaced, tend to recover their original positions. The same tendency is observed in other substances, glass, ivory, steel, air, and all gases, which are more or less elastic.

Q. In how many different states does matter exist?

A. Three: Solid, liquid and gaseous. A piece of ice is solid, water is liquid, steam is gaseous.

Q. How may any substance be made to pass from one of these states into another?

A. By increasing or diminishing the amount of heat it contains, water is converted into vapor by heat, and into ice by cold.

A. A decrease is called contraction.

Q. Suppose two polished plates of glass or metal are placed one on the other and slightly pressed.

A. It will be found if we undertake to separate them, that they stick together.

Q. What is the force that holds them together?

A. Attraction of adhesion. The air is forced from between the plates. The atmospheric pressure resists their separation. They can be separated easily by sliding them over each other, allowing the air to replace the vacuum caused by pressure.

Q. Does attraction manifest itself between bodies at a distance, as well as those which are in close contact?

A. It does. The earth attracts all bodies, and causes them if unsupported, to fall towards its surface.

Q. How can this be explained?

A. The earth is a magnetic body. All substances are more or less magnetic, and are as a consequence held together by their different attractive or magnetic capacity in a greater or less degree.

LETTERS FROM ENGINEERS

IN ORDER to make this department of THE PRACTICAL ENGINEER as interesting as possible, a moderate rate will be paid by us for all contributions published under this heading. However, we do not assume responsibility for the ideas or opinions expressed. None need hesitate to contribute because of inability to draw or write well. We will redraw or revise whenever necessary—it is the idea we want. New ways of doing old things, criticisms of accepted theories, and general engine-room experiences are especially solicited.

Broken Crank Pin

Cause and Remedy

Editor PRACTICAL ENGINEER:

In 1900 I was employed in an engine shop, as a floor hand, the shop was rather a marine engine repair shop, for they seldom built any new work. One morning the foreman told me to pack my tools and go down to a small town not far from the city of Buffalo and see what was the matter with a small vertical centre-crank engine of our own make. I was to report to him just as soon as possible the condition of affairs. In due time I arrived at the plant which was a 14″ x 16″ vertical centre-crank engine. This was all I saw, for as soon as I got into the engine room the engineer, who was was very much worked up over the trouble he was in, rushed me right to the engine and wanted to know right away what I thought was wrong. Well I looked the engine over, questioned the engineer quite a bit and came to the conclusion that something was wrong with the crank pin. The first very thing I done was to have the engineer put a bar into the pry-off wheel) or rag wheel), and to try to pry the engine I then placed my hand on the strap connection and the bell of the crank. The first pry convinced me that the pin was broken, I took down the brasses, looked them over carefully, found the butt brass broken, and the other one so badly worn that a new one was necessary. I next took off journal caps, and examined the journals. They were O. K. Looked over the shaft and saw that it was a standard ″14 x 16″ size, so I stepped to the nearest telephone station, and ordered a new one shipped at once, making sure of the key ways in each end to be just the same as the broken one. We took out the broken crank, took off the coupling (no easy matter), and the rag wheel, we were then ready for the new crank. The engineer told that it was the second time that the engine had broken the crank pin in two or three years, but that it was the first time since he came there. The infuriated manager and part owner came in just about this time and wanted to know what was wrong, and when I told him he stormed and tried to blow the roof off the building, so to speak, but I paid no attention to him, neither did the engineer. I resolved to find out if possible just where to place the blame, and when I did it was at his own door (supt's); on careful examination I found that the whole trouble lie in the fact that the shaft had no thrust collar, the conditions were as follows: This engine turned, in addition to a fly wheel and a band wheel, a bevel gear directly on the end of the shaft, this bevel gear drove another gear at right angles to itself, the latter gear being on a shaft directly connected to a stone crusher, which was very hard on the engine, being connected up direct (the superintendant said he was tired of slipping belts and he was just going to have the thing a positive drive or not at all), so he took the fly wheel and band wheel off of the crusher and connected it up direct. Well, the result was that every time that material was put in the crusher it threw a heavy load on the bevel gears, which in line threw a load against the shoulder of the crank on the front side, which naturally had a tendency to break the crank pin, which proved the weakest point in the whole shaft from end to end. The appearance of the break showed as though it (the pin), had been hot many times and cooled with water, for the outside or bearing side of the pin showed evidence of crystalization, peculiar to iron having been chilled. When we got the new crank shaft, and everything in readiness to put it in, journals sized up, lined up brasses fitted to pin and journal bearings coupling on good and tight, we set the crank in, nicely connected everything up, and were, you might say, finishing up, when the superintendant stepped up and I told him that I thought he ought to put some thrust collars on the shaft. He said, "why I took them things off, theywere getting hot all the time and I could not see where they were any good, so I took them off a short time before I hired this engineer, I recall now his saying that they must be some good or they wouldn't be put there, etc., but in my haste I paid no attention to him. He showed me where they were, and on examination I found the reason that they had run hot, they had no oil creases in them at all—any reason why they should get hot? Well, I cut good deep grooves in each side of each collar, and in the face of the thrust bearing also, the fixed collar that clamps to the shaft, I divided up the end play that the collars of the crank shaft had between the main journals, favoring the front one, or rather giving it the more space, I then tightened up fixed collar on shaft so that a piece of paper could slip freely between the driving collars all the way around, all in readiness, engine oiled, steam up, cylinder drained. The engineer started up, carefully. Well, barring a slightly warmed pin, and back journal the first day, that engine has run almost continually since and it does the work nicely. The outcome of the job was that to-day I am employed by the same company, and, well, I don't have much hard work to do.

C. W. DUNLAP.

Vulcanized Fibre in Cross-Head Gibbs.

Editor PRACTICAL ENGINEER:

For some time complaints were coming into the shop where I was employed as a floor-hand, that the engine on a dredge was giving a great deal of trouble with hot cross head gibbs, and that the engine surely must be out of line. So finally one day that it stormed so that the dredge could not work, I was sent aboard to make a thorough examination of the trouble and repair it if possible. In due time I took down the cross-head, took out piston and connecting rod, and ran a line through cylinder out over crank pin for the engine was a 14″ x 16″ side crank, solid cross-head with old style gibbs of the type that are followed up with liners of tin, etc., as they gradually wear away. Well, these gibbs were quite well used up; sufficiently so that I could get 3″ on the face with no trouble. I found that the engine cylinder, guides and crank-pin all right as to line. Then I carefully examined the cross-head gibbs and there I found the trouble, they were too soft for the strain put on them and they seemed to wear off like soap on a file; of course not so fast. Well, the question of repairs was at hand. I knew just how much was needed on the gibbs and could have

had them made from patterns we had, but it would take too long. The engineer seemed put out when he thought it would take perhaps three days to get the gibbs ready for service. When a novel scheme struck my mind and I repaired the gibbs in the following way. Vulcanized fibre is used on dredges employing friction gear, for the frictions and for the brake straps or bands, there was plenty on the dredge of different sizes and thicknesses, and got a piece 3-16″ thick, cut it out the right size with a hack-saw. Fitted it on to the bearing side of each gibb. Marked off sufficient holes in each piece and drilled fibre, liner and gibb together. I counter sunk holes in fiber to let a copper rivet-head into it sufficiently to prevent the copper striking, or bearing, rather on the guide bar. I rivited them all on nicely, then I spotted each gibb down 'till it bore evenly on guide bar, cut in usual oil grooves, and holes. Built up the cross-head again and tried it with the line. Found it all right after some little adjustment, I then connected engine up for a trial. Some of the men seemed to think it would not work, but when I tell you that that engine ran over two years without any more than three adjustments of the gibbs you should be convinced of the practicability of the trial. It don't seem possible that the fibre could be used for two directly opposite purposes. However, the above is proof of the pudding, etc.

"Arkansaw Wes."

A Short Talk With a Beginner

Editor Practical Engineer:

As I was sitting in my engine room one day, a young friend of mine came in. He had been to the examiner for a license to allow him to run an engine. His first words were, "Do all slide valve engines have only one valve?"

"Why do you ask me such a question?" I asked, and he replied that the inspector had asked that question, and that when he had said "yes," the inspector had laughed at him.

Being willing to tell him as well as I was able, about the riding cut-off valve, I replied: "No. Some are made with a riding slide valve; that is, one valve slide upon another. The purpose of such an arrangement," said I, "is to cut off the steam early in the stroke, which is impracticable with the ordinary slide valve; as the earlier the cut off, the earlier the compression begins. With the riding cut-off valve, the lower one is the main valve, and the upper valve regulates the cut off; and is, therefore, the cut-off valve."

To make my explanation still more clear, I drew a diagram of a riding slide valve (see Fig. 1). "The main valve *a*. is nothing more than a plain slide valve upon which the top plates *b.b.* move, which with the stem *c.* forms the cut-off valve. The stem is threaded with a right and left hand thread for adjusting the point of cut-off as may be desired. To set these valves, the main valve is set to give equal admission, which is done precisely in the same manner as setting a plain slide valve, after the main valve has been set. Then place the engine on one dead center, and measure the distance from the face *d* of the main valve to the face *e* on the same end of the riding or cut-off valve. The difference in the measurements will be the amount the valve must be adjusted, one half of which is taken up by changing the length of the valve stem, and the other half by shifting the eccentric. Then move the engine ahead in the direction it is to run until it cuts off, and measure on the guides the distance the cross-head has travelled from the end on the return stroke. If the two measurements are the same, the valve is set correctly; if not, adjust one-half the difference of the two measurements by changing the length of the valve stem, and the other half by moving the cut-off eccentric; then replace the steam chest cover, and the job is over."

"Is there any way of increasing the horse power of a slide valve engine?" was his next question.

"Oh! yes," I responded, "There are three inexpensive ways of doing so without any great change in the engine. The first, is to increase the boiler pressure if it can be done with safety. The second method is to lengthen the cut off by re-setting the valve, which is done by moving the eccentric backwards on the shaft, but this also changes all the other events occurring at each stroke, and in the end would not, in all probability, prove satisfactory. The most feasible method of increasing the power is to speed up the engine by regulating the governor. If this does not give the required speed, the pulley must be changed, so that the governor will maintain its ordinary speed, notwithstanding the increased speed of the engine. Another, but more expensive way, is to replace the cylinder by a larger one, though it is not advisable to increase the diameter over two inches, as the remaining parts of the engine would not be properly proportioned to stand more than this increase of power safely."

"Why is it," asked he, "That high speed automatic engines are used so much in connection with electric lighting? Why would not a common slide-valve engine do just as well?"

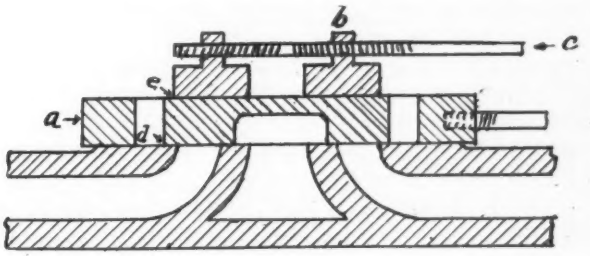


fig 1.

"To answer your question would make quite a story," I answered. "Twenty-five or thirty years ago, the slide valve engine was employed for all kinds of work, and with very good results. They rated from 10 to 130 porse power, and ran at a speed of from 80 to 150 revolutions per minute, and were regulated by a fly-ball governor. When the dynamo began to be introduced, the armatures were small in diameter, and run at a high rate of speed. These engines were not adapted for any increase of speed, which was necessary, in order to obtain satisfactory work from the dynamo. Counter shafts were used between the dynamo and engine to increase the speed, but it was found that the regulation was not satisfactory by any means, because the more times the speed was increased by means of pulleys, the greater the lack of close regulation was felt at the dynamo; and a decrease of, say, one revolution of the engine, would mean from ten to fifteen in the armature, causing a drop in the voltage on the line; and, consequently, producing an unsteady light. This fault was the means of producing engines of higher speed and closer regulation; and, with these changes, came the call for greater economy. Among others, was the automatic cut-off engine. With the introduction of the modern speed generators, an increased speed

of engine was demanded to as high a rotative speed as 350. This demand required more improvements in engine design, and resulted in a type of engine known as the high speed automatic cut-off engine, with a centrifugal shaft governor, such as I have to operate my dynamo. The advantages of the automatic engines, are, a possibility of close regulation, a wider economical range, and a reduction of cylinder condensation over engines of a slower speed. They reduce the floor space for a given horse power, and the initial cost is lower. There is a loss, however, that offsets these advantages somewhat, viz:—losses occasioned by excessive clearance, although this can be reduced by employing a piston valve of greater length, and independent steam and exhaust vales, which reduces the length of the steam ports and the piston clearance. Much might be said as to the advantage or disadvantage between throttling and automatic regulation. Undoubtedly, engineers, as a rule, are deeply prejudiced against a throttling engine, as it is doubtful if there is a throttling engine built that will regulate closer than four to five per cent.

After a little more chat, my young friend departed, and I'll venture to say he he'll soon be a candidate for a higher-class license, as he seems inclined to ask questions.

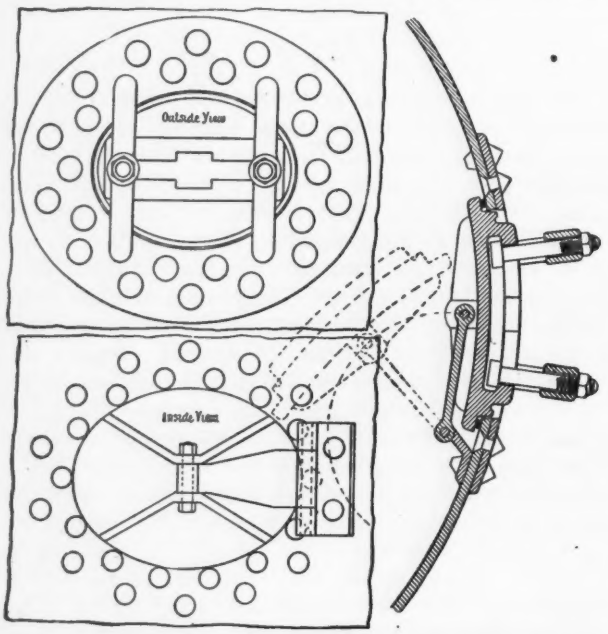
OWEN MORE.

Manhole Covers

Editor PRACTICAL ENGINEER:

I have recently had occasion to change my position. Where I am now employed I have twenty boilers under my care. The water used contains considerable vegetable matter necessitating frequent shut downs to wash out the boilers. I enclose a drawing of the style of man-hole cover used on the boilers which I have found to be quite the handiest thing of the kind I have ever seen and I think it will interest my brother readers of the PRACTICAL ENGINEER.

The device is intended to save the labor of taking the man-hole plates out of boilers and lifting them to a place of security,



and then going to the annoyance of replacing them after the work of cleaning the boiler is finished. By loosening the nuts on this man-head, a slight push swings the head in as though it were a door, and it fits back in place against the drum without occupying any appreciable amount of space, and it is always there when wanted. The parts do not become misplaced and being hinged the seats come together in the same place each time.

The amount of time saved by the use of this device is so much that I wonder that it is not more universally used and I would like to have the opinion of other engineers upon the subject. The drawing practically exemplifies the appliance so that its operation can be understood. I. B. G.

A New Type of Gasket

Editor Practical Engineer:

In your current July issue I have read something of the troubles some engineers have with their man-hole gaskets. The following is descriptive of a means of making gaskets for that purpose, which I have found to be very effective, and also saving me considerable labor.

First, I clean the plate thoroughly, then heat it pretty hot. After it is hot I ascertain that it is level. I then arrange a means of keeping the hot metal in place, after which I pour melted lead in, or around the plate, until it is full; this I permit to harden but not to become to cool. While still hot I put the plate back in the boiler and tighten down to its place. In this way I secure an impression that will not permit of the slightest leakage. In addition to this, there will not be any annoyance from the gaskets sticking as they always come off with the plate. There may be some fear that the lead might melt, but as the melting point of lead is 594 degrees F. and the temperature of steam at 150 pounds pressure is less than 365 degrees F. There will be very little danger from melting.

FRANK MORGAN.

A Few Points on Lever Valves.

Editor PRACTICAT ENGINEER:

In a great many plants one will find engineers adopting lever valves for all purposes—some using this handy device for water pipes alone, while others even go so far as to use valves of this type for steam admission to the engine. Now, while I think the lever valve one of the handiest things there is upon water pipes, I do not think a careful, well thinking engineer, would use one upon steam pipes.

In closing the cock one should remember that no valve under pressure should ever be closed suddenly; large valves are equipped with mechanisms to prevent this being done. A large percentage of accidents from the bursting of pipes is due to suddenly closing a valve, against a high pressure, when the cock has been open for some time, the stream will be flowing through at a high velocity; the momentum of such a stream is very great and a sudden stopping of this momentum is bound to produce a severe shock on the side of the valve and the pipe next the boiler. This shock may be great enough to break an elbow, burst the pipe or even tear the pipe loose from the boiler, and as a result somebody may be badly scalded and a boiler laid off for repairs.

Thus it is easy to realize the folly of using fast closing valves upon high pressures.

E. B. GRUBB.

QUESTIONS and ANSWERS

THE editor will be glad to receive from the readers of THE PRACTICAL ENGINEER, such questions relating to engineering subjects, as may, from time to time, occur to them. All questions and answers should be addressed to the editor and accompanied by the name and address of the writer, which will not be published, however, unless especially desired. It is the intention that questions shall be answered by the readers, and even though the editor may, from time to time, publish answers and questions, he especially desires the readers in such cases to contribute any further information, in connection with the points raised, that they may consider of interest. All questions and answers received by the editor will be published, as far as practicable, but he reserves the right of editing or rejecting any communication.

Editor PRACTICAL ENGINEER:

Will you kindly answer through your columns the following questions: I am a young engineer and have a position as second man at an electric light plant and water works. We have an Alfree engine 14″ by 14″, running 275 R. P. M. I go to work at midnight and work until twelve o'clock the next day, when I take charge the load is off to about 75 amperes, The chief engineer carries about 90 pounds pressure on the boilers and runs with the drain cocks partly open, while I close the drains and drop the boiler pressure to about 60 pounds, when I find that the engine runs smoother; which is the better plan?

We have a side play in the cross-head pin of about $\frac{1}{8}$-inch and the piston in the stuffing-box is 1-16 inch low which causes the engine to run hot. I have asked to have this repaired, but the chief says it will do as it is.

A YOUNG ENGINEER.

A man who will deliberately run his engine with the drain cocks open in order to reduce the speed of his engine is either woefully ignorant of the first principles of engineering, or absolutely careless of his employer's interest—which is worse. In running the engine with open cocks you simply reduce the boiler pressure against the piston by permitting a good portion of the steam to escape without getting the least benefit from it, and it costs money to generate the steam thus wasted.

The higher pressure steam is the best to use, but let the governor do the regulating, don't attempt to reduce the speed in the same manner your chief uses.

The side play should be taken up on the cross-head pin and the piston should be centred by all means.

A general description of the action of steam in the cylinder and the governor cut-off follows:

The most economical engine is the one in which high-pressure steam can be used during such portion of the stroke as may be necessary, then quickly cut off by a valve which shall not interfere with the exhaust at the opposite end of the cylinder, and allow the steam to expand in the cylinder to a pressure which shall not fall below that necessary to overcome the back pressure on the piston. In general, the most successful cut-off engines use the boiler pressure for a distance of one-fifth to three-eighths of the stroke from the beginning. At this point the steam is cut off and allowed to expand throughout the balance of the stroke.

The gain by expansion consists in the admission of steam at a pressure much above the average required to do the work, and allowing it to follow but a small portion of the stroke, then expending to a lower than the average pressure at the end of the stroke. The mean effective pressure on the piston is that by which the power of the engine is measured, hence, it follows that the higher economy is to be reached, other things being equal, where the mean effective pressure on the piston is highest when compared with the terminal pressure, or the pressure at the end of the stroke. In order to get this, a high initial pressure is used; the steam follows as short a distance as possible to keep the motion regular under a load, and then expanding down to as near the atmospheric pressure as possible.

The following table exhibits at a glance the performance of a non-condensing engine cutting off at different portions of the stroke. The initial pressure of steam being in each case eighty pounds per square inch.

CUT-OFF IN PARTS OF THE STROKE

	$\frac{1}{10}$	$\frac{2}{10}$	$\frac{3}{10}$	$\frac{4}{10}$	$\frac{5}{10}$
Mean Effective Pressure	18	35	48	57	65
Terminal Pressure.....	11	20	30	39	48
Pounds water per hour per H. P.	20	21	22	23	25

Fractions are omitted in the above table and the nearest whole number given.

Any automatic device by which the speed of an engine is controlled may properly be called governor. There are now two distinct methods by which the steam supplied to an engine is thus brought under control. The first is usually applied to slide valve engines having a fixed cut-off, and consists in the adjustment of a valve by which the pressure of steam in the cylinder is increased or diminished in order to maintain a constant rate of revolution with a variable load. The second device consists in a mechanism by which the whole boiler pressure is admitted to the cylinder, which is allowed to follow the piston to such portion of the stroke as will maintain a regular rate of revolution; the steam is then suddenly cut off at each half revolution of the engine, thus furnishing a greater or less volume of steam at a constant pressure. Neither of these two varities of governors will act until a change in the rate of revolution of the engine occurs, and this change will either admit more or less steam as it is faster or slower than that for which the governor is adjusted. The commonest form of a governor consists of a vertical shaft to which are hinged two arms containing at their lower ends a ball of cast iron; as the shaft revolves the balls are carried outward by the action of what is commonly called centrifugal force; the greater the rate of revolution the further will the balls be carried outward; advantage is taken of this property to regulate the admission of steam to the engine. The action of the balls and that of the valve include two distinct principals and should be considered separately; an excellent valve may be manipulated by an indifferent governor, and so produce unsatisfactory results. On the other hand, the governor mechanism may be satisfactory in its operation, but being connected with a valve not properly balanced, is likely to cause a variable rate of revolution in the engine.—[ED.]

The best alloy for journal boxes is composed of copper, 24 lbs.; tin, 24 lbs.; and antimony, 8 lbs. Melt the copper first, then add the tin, and lastly the antimony. It should first be run into ingots, then melted, and cast in the form required for the boxes.

Double Deck Boilers

These boilers consist of an upper and lower horizontal cylindrical shell, as shown in Fig. 1. These two shells are connected by two or more necks; the present illustration shows three necks, which is the common practice. The lower shell is fitted with as many tubes as can be conveniently arranged in it, having due regard for the manholes necessary for internal

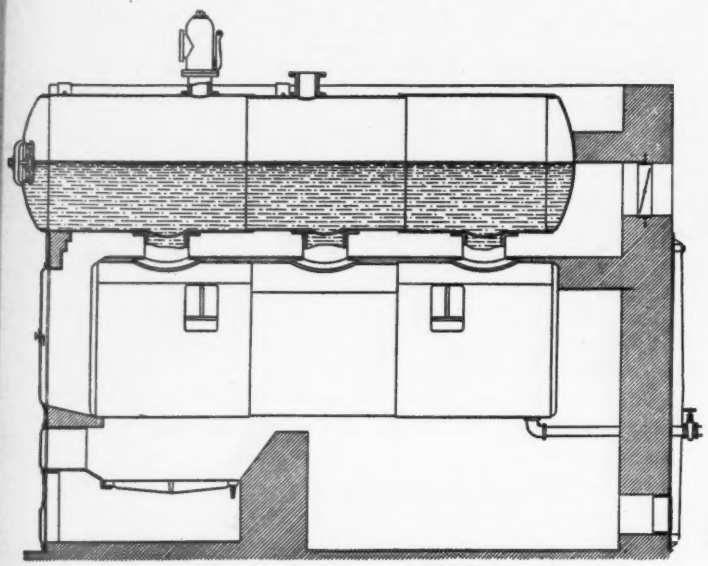


Fig. 1

examination and cleaning. The upper shell is fitted with no tubes, and is intended to be about half filled with water; these details are shown in the half-sectional elevation, Fig. 2. The The connecting necks are usually made of flange steel, and are as large in diameter as can be conveniently adapted to the two shells; the larger the diameter the better the circulation; but however large these necks may be, the circulation in a boiler of this type is not as good as in the ordinary horizontal tubular type, in which the steam-space is included in the upper part of the boiler. The only apparent reason for constructing a boiler in this manner is that of increasing the total heating surface by carrying the fire-line nearer the top of the outer shell, as well as increasing the number of tubes in a boiler of a given diameter. The circuit of the products of combustion from the furnace is underneath and around the sides of the lower shell to the rear end, returning through the fire-tubes to the front, thence, under the upper drum to the rear of the boiler; the gases then pass off to the chimney. A test of a boiler of this type, in which the lower shell was 54 inches in diameter by 12 feet in length, having 118 tubes 3 inches in diameter, the upper drum being 32 inches in diameter and of the same length, measured 1,281 square feet of total heating surface. This boiler evaporated

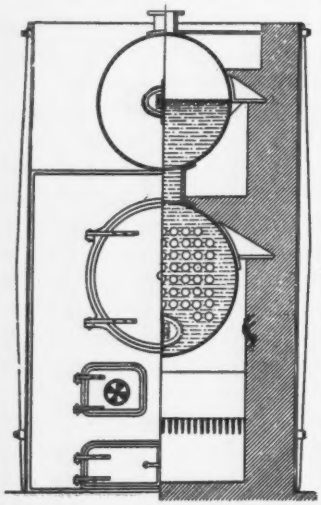


Fig. 2

10 pounds of water from 212° Fahr. per pound of coal, showing that boilers thus constructed have not sufficient advantage over the ordinary horizontal tubular boilers to pay for their extra cost.

The Triplex Boiler differs from the one previously described in having two lower shells mounted side by side, and with liberal connections from these two lower shells upward

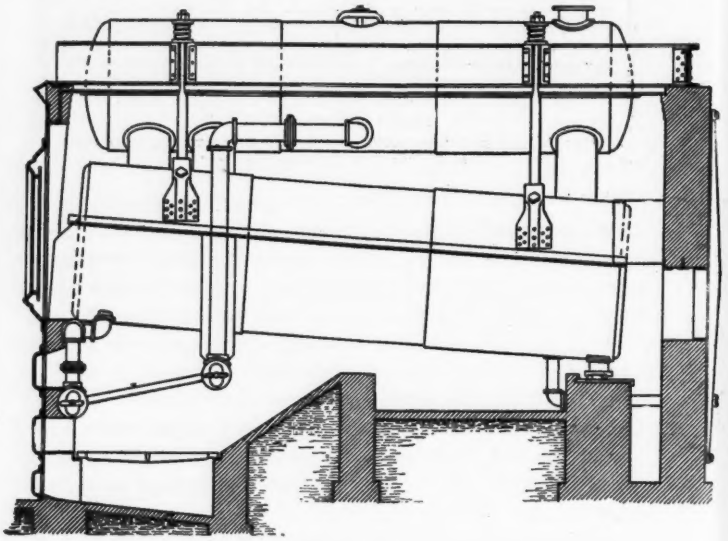


Fig. 3

into a combined water and steam drum above, as shown in Figs. 236 and 237. The circulation of the water is upward through the front connections, returning downward to the shells of similar rear connections, these being arranged, as shown in the drawings, to induce and maintain a longitudinal circulation in a circuit through the upper drum and lower shells. To avoid the difficulties ordinarily met in supporting boilers of this type, and to allow for expansion and contraction, the front ends of the tubular shells are held in a fixed position, the rear ends

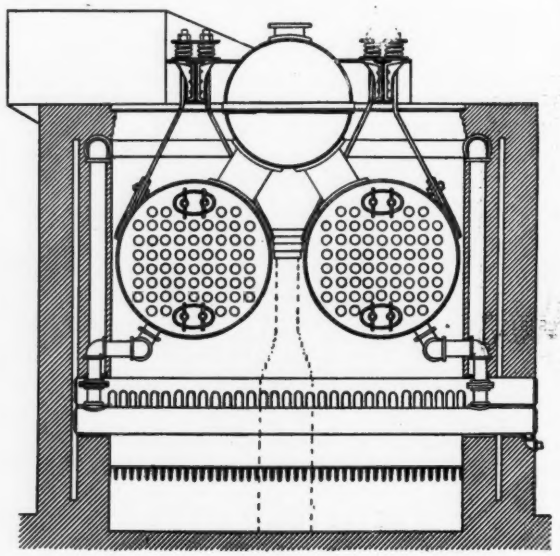


Fig. 4

being free to move backward and forward. The weight of the boiler and contents is sustained at the back partly by rollers

underneath, and partly by slings which suspend the weight from points overhead. The slings are equipped with springs, which, while maintaining a nearly uniform strain on the slings and girders, allow by there elasticity for imperfection in workmanship and adjustment, as well as for settling or other changes which may occur. They provide also for vertical expansion and contraction of the parts by changes of temperature. The slings are so adjusted that they will support about three-fourths of the weight, leaving the other quarter to run on the rollers.

The Relative Value of "Teon" Belting

The recent appearance on the American market of a belt manufactured in England has caused some speculation as to what are the mediums of power transmission most generally in use on the other side of the water. Are we ahead of them in the manufacture of belting or have we yet something to learn?

A glance at the export records shows that the United States sends annually to England, large quantities of leather and cotton belting, and receives only one kind of belt in return.

This English belt which has of late come into much prominence here is of a different type from anything manufactured in America, although it has always been a favorite throughout England and the continent.

It has sometimes been described as of the balata type, although "Teon," which is the best of the English belts, and the one seen here, is not balata but a woven composition somewhat resembling it. It is built up in plies and cemented together under pressure without joint or seam, then sewed and riveted with several rows of closly set metal rivets.

One of the chief factors of "Teon" is the cement, which is a secret preparation and which has not been duplicated here, since in the manufacture of cements we are far behind the English.

The cement used in "Teon" will stand a temperature of 230 degrees Fahr. and is not affected by heated steam or even temporary contact with flame. Neither is it injured by water or chemicals, which together with its ability to withstand extreme temperatures, partly accounts for American mill owners having found it to be more efficient for many drives than any other belt.

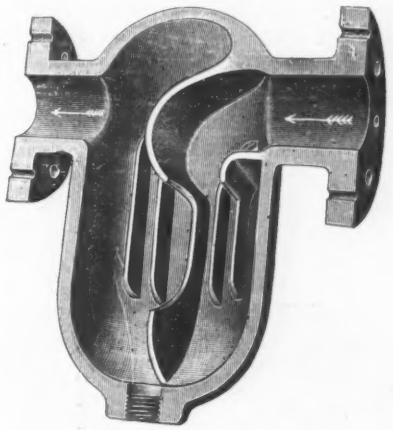
"Teon" seems to have come largely into use for exposed places and severe conditions, such as exist in drying rooms, dye houses, chemical works or on outdoor drives. The writer recently saw one, which had been running for many months with elevator buckets, totally immersed in a puddling pond, in which the liquid was never less than 80 degrees Fahr. This belt is also popular in laundries, breweries, pulp mills, or wherever the belts come in contact with liquids.

In selecting a belt, there are other elements to be taken into consideration beside its ability to withstand the conditions under which it is to run. The lightest belt which fills the bill will, of course, save the most power. There has been some discussion as to the relative merits of "Teon" and leather in this respect. The manufacturers of the imported belt, however, claim that a comparative test recently made, on a dynamo, showed that a six-ply "Teon" belt did perfectly the work of a double leather and saved much horse-power, owing to its lighter weight and greater pliability. They also claim that the specially prepared driving surface of "Teon" is superior to that of any other belt, and is, therefore, less likely to cause annoyance by slipping.

"Teon" has heretofore been largely used here as a "wet weather belt," for which its superiority is undoubted, but if the claims as to its driving powers are correct, there seems to be no reason why it should not come into general use, as to perhaps make imports in this line greater than the exports.

The Paterson Separator and Oil Extractor

The accompanying illustration gives a very good general idea of the internal construction of the Patterson steam separator and oil extractor, which has been designed after long experience with such devices. It will be seen that the steam does not meet any obstruction at right angles with its course on entering, but the deflector is so curved that the current of steam and water is deflected in an easy natural path without shock or loss of pressure. The deflector is so shaped that the water is thrown instantly to the side of the separator, striking it at a gentle angle, it is then passed down into the reservoir at reduced velocity. The movement of the water is instantly checked at the bottom by means of a large diaphram which reaches entirely across the reservoir with the exception of a space which is left to provide communication between the two chambers formed by the partition. The steam passes



under the deflector and makes an abrupt turn in passing up to the outlet, so that whatever water remains is thrown to the bottom by centrifugal action.

The Patterson Separator is provided with deep ribs which operate in the form of channels to conduct the water to the bottom without any possibility of disturbance by the passage of steam through the separator.

Great care has been taken to design this separator so that there would be no loss of pressure, as the passage through the device is nearly twice the area of the steam pipe and as the separator is generously proportioned, the velocity through it is very much reduced, thus materially facilitating the separating action.

The Patterson separator is made in both horizonal and vertical styles and both are provided with an extra large hand hole, so that the separator may be cleaned at any time without disturbing the piping.

Each separator is tested to 400 lbs. hydraulic pressure and all castings are guaranteed perfect and to be of the best quality of close-grained iron with thick walls and heavy flanges.

With each separator are included two companion flanges with bolts for same, one set of good quality gauge-glass fittings and glass.

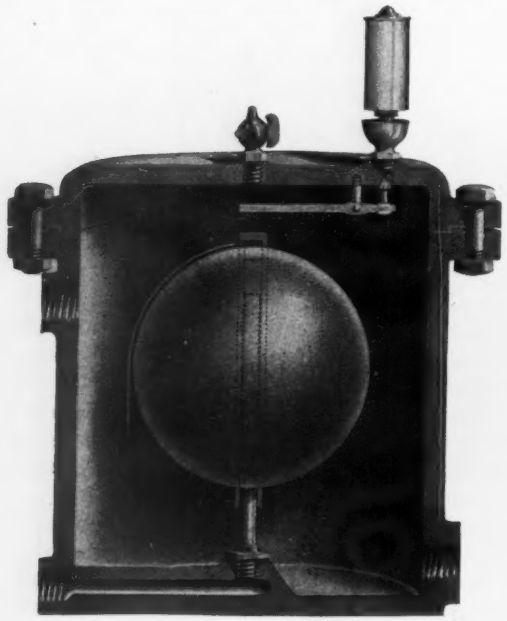
In regard to the efficiency, the makers guarantee that after passing through separator the steam will not contain more than one-half of one per cent. moisture, provided the entering steam does not contain more than 10 per cent. of water, and that with 20 per cent. entrainment the steam will be at least 99 per cent. dry, provided the separator is not unreasonably overloaded. It is made in both horizontal and vertical styles by Frank L. Patterson & Co., 24 Cortlandt Street, New York.

The Lindstrom Trap

The value of a steam trap is beyond question, so far as economy is concerned, but the point what trap to use is open to much discussion. The accompanying cut shows the Lindstrom steam trap, which has been devised specially for discharging all condensed water, which may accumulate in the steam system. The trap is so constructed as to be available in returning the water to the boiler or in discharging the wastes to the atmosphere.

The primary object has been to provide a trap which, while being simple and effective, will at the same time operate automatically in taking care of the excessive flow of water into the steam system. The trap is constructed of cast iron, with the cover of the same material. A commendable feature is that the cover is fitted on with a ground joint fitting, thus obviating the necessity of using packing of any kind.

The inlet to the trap is near the top, the outlet at the bottom,



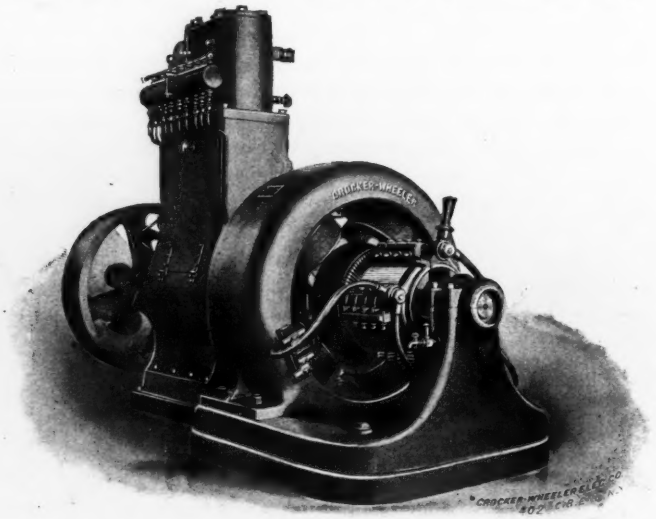
opposite the outlet is a blow-off, which is to be used to empty the trap when it is not in use, also to blow off impurities that may accumulate in the trap.

The construction and the working of the mechanism is very simple. As can be seen at the bottom is a cored outlet, into this outlet is a brass post having a taper ground seat with openings to outlet screwed in. To this post is fitted also a brass tube which is in connection with the copper float sliding free on the post. At the top of this tube is a smaller tube screwed in following the circle of the float, and extending down below the water line. This small tube is to give the float a free movement on the post and to prevent any vacuum being created between the post and the top of brass tube which is closed at the upper end. The automatic alarm which is connected to the cover or lid, is screwed in and a ground valve fitted below the whistle. This valve is also fitted to a lever having a fulcrum, the lever extending to the centre of the trap. Should the outlet become clogged up from scale or any other impurity, the water coming in the trap would arise the float and come in contact with the lever, and by this the small valve will be opened, and the whistle will alarm. At such times it would be necessary to remove the lid, and lift the float off the post and clean the trap. This can be done in a few minutes, as there is no gasket to scrape off and no packing needed.

Further information may be had by addressing JOHN T. LINDSTROM, Allentown, Pa.

A Small Direct-Connected Set

The small direct-connected set illustrated in the accompanying cut is intended primarily for marine use, that is, for furnishing light and occasionally power on shipboard, but it is a mistake to consider that this is the extent of its field of usefulness. There is also a considerable demand for such a piece of apparatus in isolated plants. For example, it is an ideal equipment for supplying current for lighting in summer hotels, or power in small shops where current from a large central station is not available. Among the principal characteristics which peculiarly adapt it to this field are its lightness, compactness and low first cost. Moreover, it is possessed of a very



fair efficiency, considering the fact that it is driven by a simple engine, usually operated on medium pressures, and run non-condensing. The outfit under discussion consists of a 6 x 5-inch Sturtevant double engine, direct coupled to a 24 KW, size 35, Form D, Crocker-Wheeler dynamo, and running at 500 revolutions per minute. With the usual allowance for loss in the mains, this machine is capable of lighting upwards of five hundred 16 candle power lamps, the maximum depending on the amount of overload that may be carried consistently. As far as the generator is concerned 40 per cent. or even 50 per

cent. overload is allowable for a short time, but an engine is seldom capable of standing so excessive an overload. If the the set is to be operated but a short time, say five or six hours out of the twenty-four, a greater latitude is permissible, and will not cause undue heating, but where almost continuous service is required, somewhat near the normal rating must be preserved.

The illustration indicates a number of the commendable features possessed by this outfit, among them, protected construction, particularly noticeable in the engine, and provision for automatic lubrication of all wearing parts, by means of a gravity oiling system, the reservoir for which is located beside the cylinders. The generator is less protected so far as the elimination of dust and foreign particles are concerned. However, this is an advantage inasmuch as the open construction allows for a very perfect ventilation of the armature and windings, and reduces excessive heating. As a rule, a location may be selected where dirt, moisture, or inflammable material are not present, and here the open construction is no disadvantage, but in case this is impossible, a closed type of generator may be substituted.

From the standpoint of operation, other points of excellence are its close regulation afforded by means of a sensitive governor, completely avoiding any disagreeable flickering of the lights, and the careful design and construction of all the parts, so that there is very little to get out of order, obviating the annoyance of shutting down for repairs.

The engine builder is the B. F. Sturtevant Company, of Boston, Mass., and the Crocker-Wheeler Company, Electrical Engineers and Manufacturers, Ampere, N. J., furnish the dynamo.

The Commutator

The commutator is the most sensitive part of the dynamo, and should be especially cared for. It must always be kept smooth. If it should get rough from the electric spark, it is necessary to smooth it by pressing a block of wood covered with fine emery cloth against it, after having set the dynamo in motion with the brushes lifted off. If the commutator is so rough that a smooth surface cannnot be obtained by the use of emery cloth, it should be filed. In order to do that it is necessary to take out the brush holders, pins and brushes. After a straight surface has been obtained, the commutator should be smoothed with fine emery cloth.

The disadvantages of using a file on a commutator are the liability of pressing small chips of copper into the insulation between the copper segments, and the impossibility of getting the commutator true. The best way is to turn the commutator off by means of a little lathe which can be attached to the dynamo, or by taking the armature out of the dynamo and having the commutator turned off in a lathe in a machine shop. This will not only make the commutator smooth but perfectly true. In filling or turning off the commutator while the armature is rotating in the dynamo, it is necessary to reduce the speed of the dynamo considerably, as too high a speed would spoil the commutator and turning tools.

In most systems it is advisable to put a little oil on the commutator just after starting the dynamo. Very little oil, however, must be used. Dip the point of one finger in one drop of oil, distribute it by rubbing it on the inner surface of the hand and apply what oil remains on the finger tip to the commutator, and take it off with another finger. This will do for at least three hours' run

If it should become necessary at any time to replace the commutator by a new one, it should be sent to a competent electric firm.

A Good Day at Reading

Saturday, September 12, was a banner meeting for Progress Council No. 13, of Reading, Pa., in that they entertained visiting delegations from Pottstown No. 14, Columbia No. 18, and Sunbury No. 19. The visitors all attended the regular meeting, which was an interesting one, four new members being initiated. After the meeting the visitors were banqueted at Barbey's Cafe, In all there were 150 at the tables, and the affair proved a very enjoyable one for all present. The following visitors remained until Sunday evening and enjoyed the many interesting sights in and about Reading, including a trip over the famous Neversink Mountain. Of Pottstown: Joseph Rhodes, Harry Zoller, Jacob Crater, James Warmkessel, Clayton Fink, Toby Pieman, Franklin Reinert, Wm. Rickert and H. L. Shirey. Of Columbia: Wm. J. Courtney, Albert Kimes, Ambrose Bartch, John Schlossman and James Debine. Of Sunbury: Ed. Schreiber, Aaron Buck and H. E. Culp.

The entertainment committee, composed of Al. Keppleman, F. S. Miller and Grand Chief Trout, were heartily praised by the visitors for the most excellent manner in which they were entertained.

Iron City Council

The officers of Iron City Council, No. 21, of Pittsburg, Pa., are as follows: Chief Engineer, F. C. Rose; Assistant, Martin Kane; Financial Engineer, Philip Sutton; Treasurer, M. J. O. Sullivan; Recording Engineer, Geo. J. Peters; Corresponding Engineer, A. Frazer; Senior M. M., J. F. Andrews; Junior M M., Mat Tierman; Chaplain, J. J. Kane; Inside Sentinel, J. O. Cowger; Outside Sentinel, J. Hart; Trustees, J. J. Stewart and Lewis Vandergrift.

Lehigh Council

Lehigh Council No. 15, of Allentown, Pa., celebrated their fourth anniversary last month and the "boys" turned out in force. The council now has 112 members. A gold badge has been offered as a prize for the member presenting the greatest number of applications during the term and the contest is spirited; the last returns showed Past Grand Chief Dreisback in the lead with some others close up.

Lehigh Council will hold a prize drawing on August 14th, the prizes will be a steam engine indicator and a gold watch.

The wife of Thos. F. Hoch, a charter member of Lehigh Council, died on Friday, August 7th. Resolutions of respect were passed by the council at their regular meeting on Aug. 12.

To Keep Metals Bright

A good rust preventive is made as follows: Dissolve one ounce camphor in one pound melted lard, remove the scum; mix as much black lead with the lard and camphor as will give it an iron color; clean the machinery well; smear with the mixture after twenty-four hours' rub off; clean and polish with soft cloth.—*London Engineer.*

TRADE NOTES

There are few oil houses as popular with engineers as that of O. F. Zurn Co., 418 Vine Street, Philadelphia. This is one of the oldest lubricating oil houses in the country, and like some other good things it seems to improve with age, for the business increases every year, and improvements and extensions in the compounding department are frequently necessary. This department is now one of the most complete to be found anywhere and the firm are able to produce the finest cylinder and machine oils that it is possible to make They make a specialty of compounding extra fine grades of oil to order for lubricating high grade machinery or bearings requiring special attention and in this they have been very successful, seldom or never failing to give perfect satisfaction. Two years ago there was a case in the south where the cylinders of several large new engines required reboring after being less then a year in operation. This firm's attention was called to the case and they agreed to furnish a remedy. They made a special oil for the plant and the cylinders have required no further attention since.

The Standard Steam Specialty Co., inform us that they have received a letter from T. C. Smith, chief engineer for Rodgers, Peet & Co., in which he makes the following claims: "We are getting 213 degrees temperature for the boiler water at the discharge from the "Utility" feed water heater. I then pump this water through a 700 h.p. closed heater and the increase in temperature is less than one degree."

The following are some recent installations of the "Utility" apparatus: Blair Building, Healy Building, Rogers, Peet & Co., Congress Street Trust Building, Florence Apartment House, St. Joseph's Hospital, Johnson Building, Jones Brothers, John J. Crooke & Co., N. Y. C. R. R., R. H. Macy & Co

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Berry's boiler feed control is very similar to and takes the place of an ordinary water column, but it does a lot more besides. It keeps the water at a uniform level without any attention from the engineer or fireman, thus affording great protection to the boiler from the destructive effects of contraction and expansion due to variation in the water level, and at the same time protecting the engine, and saving both the fireman and the fuel. The saving in the latter alone should pay the small cost of the device within a few weeks. The manufacturers publish an interesting catalogue which they will mail to any one who is sufficiently interested to write for one. Address, Berry Engineering Co., Chester, Pa.

Metal Gaskets are gradually forcing themselves to the front in the practice of steam engineering. In order to keep well informed upon the progress made in this style of making joints it will repay the engineer to write the Standard Gasket Co., 7 South 36th Street, Philadelphia, Pa., for their pamphlet upon the subject.

D. P. Brown & Co., 264 North 4th Street, Philadelphia, inform us that they have sold large quantities of Teon Belt during the past month. This belt is made in England, and Brown & Co. are the United States agents. It is said that Teon is far superior to leather belting for every purpose and especially where it is exposed to the weather or to steam acids or other conditions which would naturally injure a leather rubber or canvass belt. It is claimed that it will resist heat up to more than 200 degrees, that it does not stretch and seldom slips. Sample and prices together with booklet will be sent free upon request.

Mechanical Stoking is now becoming a point of nterest to the up-to-date engineer, and all material upon this subject is usually much sought after. The Wilkinson Manufacturing Co., Bridgeport, Montgomery county, Pa., are sending out to readers of THE PRACTICAL ENGINEER, free of charge, a handsomely illustrated book upon the subject of automatic stoking which will be a welcome addition to any engineer's library—send for one.

Searchlight Packing will bear the strongest kind of investigation if the packing is in line with some of the exceptional catalogues and illustrations the Republic Rubber Co., Youngstown, Ohio, are issuing. The latest edition "A Talk on Packing," in vari-colored inks, is a handsome testimonal of the printers' art, as well as containing many pertinent points of value to the engineer. They are being sent out free of charge to readers of THE PRACTICAL ENGINEER.

"Something About Separators" issued by the Direct Separator Company, South Giddes St., Syracuse, N. Y., will attract more than passing attention. It contains 40 pages of well illustrated matter upon entrained water which will not only increase the readers knowledge, but will also show various successful means of deal- Mention this paper when writing for copies of the book which will be sent free to applicants.

Mr. Wm. T. Johnson, manager of the new Philadelphia office of the Dearborn Drug and Chemical Works, at 672 Bourse Building, has the following to say about Philadelphia engineers: "I never met a better lot of fellows; they are not only good engineers who know how to run their plants and keep them in good condition, but they know how to treat salesmen who call upon them. They give us orders too, and that's additional proof that Philadelphia engineers know their business.

Mr. V. O. Lawrence the genial and happy secretary and treasurer of the Geo. W. Lord Co., of Philadelphia, has just returned from a three months trip to Europe. He says he had a good time, and he also says that as far as boiler compounds are concerned, the "American Invasion" of Europe is complete. Mr. Lawrence says that Lord's Boiler Compounds are almost as well known in the steam plants of London, Paris, Berlin and St. Petersburg as in the cities of the United States.

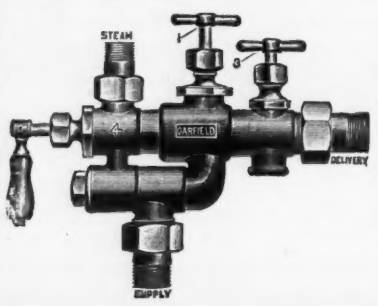
The Heilman James Co., manufacturers of Plastic Metallic Packing, have removed to 523 Locust street, McKeesport, Pa., where they will have a larger factory and better facilities for producing their packing which is now in great demand. This packing, as its name implies, is composed chiefly of metal, but in plastic form it fits any rod and is said to possess remarkable wearing qualities. The company send it on trial at their own expense. "No keepe no payee."

The General Engineering Co., 764 Sansom street, have recently completed repairs to the engines of several large steamships. They now have a large force of expert mechanics in their employ and their shops are equipped with new tools and machinery of the best patterns for repairing engines and pumps, or building special machinery to order.

If any of our readers are interested in grate bars, indicators, or flue cleaners, they should write to Richard Thompson & Co., 126 Liberty Street, New York, for their catalogue. It also contains a description of the new Thompson Damper Regulator, which has several points of merit worth considering. When writing for catalogue mention THE PRACTICAL ENGINEER.

Mr. A. DeHaber, a mechanical engineer who has held many responsible positions in England and Russia and for sometime past has been in the employ of the Baldwin Locomotive Works, has recently accepted through Hapgoods, of the Pennsylvania Building, Philadelphia, a position as manager of the H. B. Harris Smoke Consuming Furnace Company, of Philadelphia.

The Lamprey Co., of Westfield, Mass., have removed their Philadelphia office to 240 Chestnut Street, larger quarters being necessary to accommodate their rapidly increasing business. They have just equipped four National Water Tube boilers at Strawbridge & Clothier's new plant with the Lamprey arch plates.



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Equipped with Garfield, Double Jet Injectors and Chicago Sight Feed Lubricators are as satisfactory to the owner as to the engineer.

Boilers steam easily and engines run smoothly.

Send for catalogue and mention THE PRACTICAL ENGINEER.

The Ohio Injector Company

WADSWORTH, OHIO

The Liberty Manufacturing Co., 6905 Susquehanna Street, Pittsburg, Pa., manufacture a line of turbine cleaners for removing scale from the tubes of water-tube boilers which are well worth the attention of any engineer who has trouble of that nature. An illustrated catalogue showing their various cleaners will be mailed free to any engineer mentioning THE PRACTICAL ENGINEER.

John S. Bushnell & Co., 126 Liberty Street, New York City, are agents for the Spencer Damper Regulator. They also manufacture a number of other high grade steam appliances including indicators, planimeters, flue cleaners, etc. Catalogue and other information will be furnished those who write, mentioning this journal.

The Crandall Packing Co., Palmyra, N. Y., are issuing a neat monthly calendar in booklet form for daily memorandums which will be useful to most engineers. They will send one free to any engineer writing them and mentioning THE PRACTICAL ENGINEER.

The Otis Heater, made by the Stewart Heater Co., 11 Norfolk Ave., Buffalo, N. Y., is guaranteed to extract the oil from the exhaust.

The Burt Manufacturing Co., Akron, O., recently shipped two 15-inch and one 12-inch Burt Exhaust Heads to the American Steel and Wire Co., Worcester, Mass.

D. P. Brown & Co., 264 North 4th Street, Philadelphia, issue a little catalogue which describes some rather peculiar, but apparently effective styles of high-grade ring packings, and also a spiral packing, the style of which is a decided novelty. It's worth sending for.

Wm. F. Ruwell the well known machinist of 921 Ridge Ave., Philadelphia, is erecting handsome large new shops which he will move into shortly. Mr. Ruwell's new shops will be equipped with all the latest approved tools and machinery.

Schade & Marshall, 142 North 6th Street, Philadelphia, have accepted the agency for the complete line of specialties manufactured by The Ashton Valve Co., including pat. safety valves, steam gauges and kindred instruments.

The catalogue of the Sims Co., Erie, Pa., shows illustrations and gives descriptions of a number of steam appliances which should interest all progressive engineers. A copy will be sent free to any one mentioning this paper.

The Kruger & Blind Co., 511 and 513 Master Street, Philadelphia, and now building Keystone belt pumps, heaters, separators, and exhaust heads. They also make a specialty of reboring engine cylinders, Corliss valve forts and crank pin holes in position.

The Sterling Pipe and Blower Co., Hartford City, Conn., are receiving a large number of orders for their Sterling Exhaust Heads. These heads are guaranteed to entrap all condensations or may be returned at the maker's expense.

WANTED—Salesman to handle our automatic belt dressing machines and graphite specialties. PENNSYLVANIA CARBON-GRAPHITE CO., Scranton, Pa.

IF ENGINEERS will send $1.00 to the address below they will receive two blue prints, with tables and instructions, showing how to set valves and eccentrics on Corliss engines, simple and compound, with one and two eccentrics. JOHN T. LINDSTROM, 214 and 216 S. 3d St., Allentown, Pa.

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CROSS OIL FILTER
is apparent by the large number we are now installing.
Hadn't you better get one to try?
It is guaranteed to save you 50 per cent. in the cost of your lubricating oil, and if it doesn't you may return it at our expense, after 30 days' trial.

The United States Steel Corporation have 119 Cross Oil Filters in their different works.

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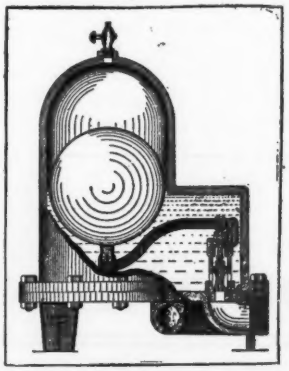
A GOOD THING



The "FORD" Compound Steam Trap
We want you to take hold of it. Made in 5 sizes. Has large outlet and the largest capacity of any Steam Trap on the market.
Write for full particulars and prices.
Thomas P. Ford Co.
SCHADE & MARSHALL
PHILA. AGENTS
319 HARRISON BUILDING PHILADELPHIA, PA.

Dixon's Flake Graphite adds to the lubricating power of any grease and any oil greatly out of proportion to the amount used. Actual test shows that one-seventh of the lubricating graphite added to the oil increases the lubricating power one-half. Ask for booklet 96-c.

Joseph Dixon Crucible Company, Jersey City, N. J

Cochrane Steam Separators

Several months after we installed one of our Vertical Cochrane Steam Separators in a large carpet factory here in Philadelphia, we asked the engineer how it was working.
"Well," he said, "it is the best thing for the protection of an engine I ever saw. Why, more than once, when the boilers have primed, if it had not been for that Cochrane Separator the engine would have been on the scrap heap."
Practically the same thing has been told us many times by users of these "Cochranes," all over the country, and consequently we can scarcely make an estimate of the number of broken cylinder heads and bent piston rods that have been prevented by Cochrane Steam Separators.
For taking water out of steam, whether it is present in large or small quantities, and whether its presence is caused by priming boilers or condensation in the pipes there is no better device than the Cochrane Separator. Its capacity for taking out the water is limited only by the means provided for draining the well.
Besides this positive protection for the engine, the Cochrane Separator promotes economy, because of the greater expansive force of Dry Steam and because better cylinder lubrication can be obtained with less oil than when wet steam is supplied.
Our **Catalogue 16-S** fully illustrates and describes these Separators and gives some interesting facts about the different principles of separation—particularly about the Cochrane principle. It's free.

Harrison Safety Boiler Works
3144 North Seventeenth St.
PHILADELPHIA, PA.
Manufacturers of
COCHRANE FEED WATER HEATERS,
and of the SORGE-COCHRANE SYSTEMS.

American Order of Steam Engineers.

ORGANIZED APRIL 27, 1886.

An Order of Engineesr for Engineers and Engineers only.

DECLARATIONS OF PRINCIPLES

Believing that ability will bring its full value in this country, this Order shall at no time take part in strikes, nor in any way interfere between employer and employees. Recognizing their identity of interests, it shall take no part in any project or enterprise that shall interfere with perfect harmony between them ; neither shall it be used for political or religious purposes.

These principles shall not be amended or repealed except by unanimous vote of the Order.

Any member who shall be guilty of violating the principles of the Order shall be expelled.

OBJECTS.

First.—To promote a more thorough knowledge in its members of theoretical and practical steam engineering.

Second.—To assist members to obtain employment.

Third.—To help the sick, injured and distressed and bury the dead.

Fourth.—To establish a Widows' and Orphans' Fund.

Fifth.—To help members who shall become incapacitated from following the profession to obtain employment suited to their affliction.

Sixth.—To do our utmost to extend the license law throughout the United States.

Seventh.—To establish schools in which our members may study the highest branches of steam engineering.

MEMBERSHIP.

An applicant for membership must be an engineer between twenty-one and fifty years of age, and must be a white male citizen of the United States, of good moral character and be a believer in the Supreme Being, and be free from all physical infirmities.

He must have had three years' service in an engineering department, or if a machinist, or graduate of a technical institute, then one year's service, in such department, and in localities where engineers are required by law to be licensed, they must have such license, and must satisfy the investigating and examining committees of the council to which he applies as to his character and ability.

LIFE MEMBERSHIP.

Engineers who have passed the age limit may be admitted to life membership. They must possess the same qualifications and pass the same examination as are required in the next proceeding clause: They shall be entitled to all rights and privileges of the Order except they cannot vote on financial questions or for the election of officers or be entitled to any sick or death benefits.

DIRECTORY.

The Publication Committee of "The Practical Engineer" desires that the Corresponding Engineers of all Councils of the American Order of Steam Engineers send the name of their Chief Engineer and their own name and address, together with the time and place of meeting, to the Secretary of the Publication Committee immediately after each election of officers. Address J. C. McDowell, Secretary, in care of "The Practical Engineer," 1215 Filbert Street, Philadelphia.

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Deputy Supreme Chief Engineer, David J. Stayton, No. 513 Searles St., Wilmington.

WILMINGTON.

Delaware Council, No. 1, meets every Wednesday at S. E. Cor. Fourth and King Sts. Chief Engineer, Clark Franklin. Corresponding Engineer, A. E. Deakyne, 406 Lombard St.

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Deputy Supreme Chief Engineer, John W. Angers.

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Evangeline Council. Chief Engineer, John B. Lanaier. Corresponding Engineer, W. J. Maynard.

JENNINGS.

Jennings Council, No. 2, meets every Saturday evening in American Bank. Chief Engineer, Daniel R. Jones. Corresponding Engineer, R. E. Funk.

MARYLAND.

Deputy Supreme Chief Engineer, A. J. Deidrich, 226 North Caroline St., Baltimore, Md.

BALTIMORE.

Maryland Council, No. 1, meets 2nd and 4th Fridays in Royal Arcanium Hall. Chief Engineer, L. Smithers. Corresponding Engineer, Wm. S. Smith, 533 Sharp St., Baltimore.

Energy Council, No. 2, meets every Wednesday of each month in Bauer Hall, Chesapeake and Elliott Sts. Chief Engineer, T. E. Eaton. Corresponding Engineer, Thos. O. Daneker, 834 East Ave.

MASSACHUSETTS.

Deputy Supreme Chief for Eastern District, W. E. Packard, Whitmann.

BOSTON.

Boston Council, No. 4, meets 2nd and 4th Thursdays of each month, in the Hall, 262 Washington St. Chief Engineer, A. R. Abbott. Corresponding Engineer, Phillip Sanford.

ROCKLAND.

Old Colony Council, No. 14, meets 2nd and 4th Saturdays in the American Foresters' Hall. Chief Engineer, Herbert W. Jones. Corresponding Engineer, James K. Sedgwick, Box 333, Rockland, Mass.

NEW JERSEY.

Deputy Supreme Chief, F. O. Garrison, Bridgeton, N. J.

PERTH AMBOY.

Stevens Council, No. 1, meets 3rd Saturday, at Water, near Lafayette St. Chief Engineer, Lawrence Oliver. Corresponding Engineer, James H. White.

CAMDEN.

Camden Council, No. 3, meets every Thursday evening at S. E. corner 2d and Arch Sts. Chief Engineer, S. M. Best. Corresponding Engineer, C. H. Pfeiffer, 571 Berkley St.

ATLANTIC CITY.

Atlantic City, No. 4, meets every Tuesday evening at Merchants, Cor. Atlantic and New York Aves. Chief Engineer, John A. Best. Corresponding Engineer, W. S. Price, Haddon Hall.

BRIDGETON.

Bridgeton Council, No. 5, meets every Friday. Chief Engineer, David Sellers. Corresponding Engineer, Francis O. Garrison, Bridgeton, N. J.

MILLVILLE.

Millville Council, No. 6, meets every Saturday, 7.30 P. M., in G. A. R. Hall, East Main St. Chief Engineer, Wm. F. Pond. Corresponding Engineer, Lewis Doughty, 604 Mulberry St.

NEW YORK.

SYRACUSE.

John E. Sweet Council, No. 6, meets Monday, Room 23, Nottingham Block, East Washington St. Chief Engineer, John Cunningham. Corresponding Engineer, S. A. Steel, 311 Orange St.

PENNSYLVANIA.

Grand Chief Engineer, Hiram Trout, 1042 Locust St., Reading, Pa. Deputy Grand Chief for Philadelphia and Delaware Counties, John P. Rickards, 2707 N. Broad St., Philadelphia. Grand Corresponding Engineer, Frederick Markoe, 931 Orianna St., Philadelphia.

Deputy Grand Chief for Western Pennsylvania, A. D. Hamilton, 2025 Forbes St., Pittsburg, Pa.

PHILADELPHIA.

Germantown Council, No. 22, meets every Wednesday evening at Main and Seymour Sts., Germantown. Chief Engineer, George T. Lee. Corresponding Engineer, Frank MacIndoe, 3519 Ainsley St., Falls of Schuylkill, Philadelphia.

Welcome Council, No. 2, meets every Friday, N. W. Cor. Twelfth St. and Columbia Ave. Chief Engineer, Paul Pieling. Corresponding Engineer, L. D. Woodington, 2428 N. Bancroft St.

Kensington Council, No. 3, meets every Thursday, at A. P. A. Hall, Frankford Ave. and Master St. Chief Engineer, Ed. C. Ricker. Corresponding Engineer, Ernest Ritsert, 2229 Frankford Ave., Philadelphia.

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TRADE MARK
Tri=Sodium Phosphate
INCREASED BOILER EFFICIENCY
DECREASE IN THE FUEL BILL
REGISTERED
WITHOUT INJURY EITHER TO THE BOILER OR THE PRODUCT
This and a lot more about its prolonging the life of the boilers, is the story its users have to tell. Would you like to know what it would cost to keep your boilers clean? Send us a gallon of your feed water, the analysis free. So is our Booklet "WORTH KNOWING."
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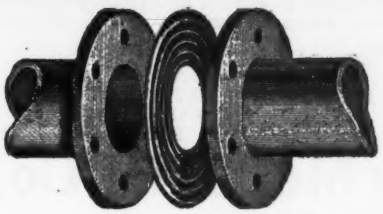

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OUR PATENTED MINERAL WOOL

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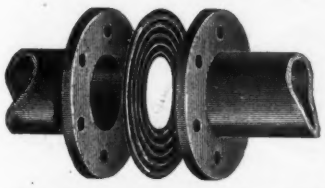

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They Save Steam and Make Absolutely Tight Joints

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BEST AND CHEAPEST SAMPLES FREE

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illustrated here is designed for Single Engines or Large Plants where many Engines are operated from one steam main. It will oil one or a dozen Engines, save 40 per cent. of Oil used with any other Lubricator, and prevent annoying leaks in Steam Pipes.

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I have not been able to run some of the best brands of packing on my 20 x 42 Corliss over three months. Your 3 P has stood one year, and has not been touched even to tighten the glands. To use it has been a great economizer in steam, due to reduced friction on the rod, and a saving in our coal bill.

CHAS. M. JOHNSON, Chief Engineer
Enterprise Box and Lumber Co., Milwaukee.

P

After trying the various packings on the market claiming to be the best, we gave your 3 P Special for ammonia a trial and had such good success with it that we have not used any other during the last four seasons. Your 3 P for steam has also given us equal satisfaction during the same period.

THE JOHN EBNER ICE CO.,
Seymour, Ind.
Per L. A EBNER

P

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FREE—Our patent steel packing rule saves engineers labor, time, trouble, temper, packing, burnt fingers and swear words. It is worth $1.00. Sent absolutely FREE to engineers who order from us enough P. P. P. for a trial and mention this paper.

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Southwark Council, No. 4, meets every Monday, at Cor. of Reed and Eighth Sts. Chief Engineer, Hugh Ryder. Corresponding Engineer, J. C. McDowell, 1913 South Eighth St.

Philadelphia Council, No. 7, meets every Wednesday, at Kenny's Hall, N. W. Cor. Broad and Filbert Sts. Chief Engineer, Harry Dunn. Corresponding Engineer, W. S. Wetzler, 3717 Aspen St.

Manayunk Council, No. 9, meets 2nd and 4th Friday evenings in Temperance Hall. Chief Engineer, Andrew Roberts, Sr. Corresponding Engineer, John Clevenger, 211 Lofty St.

Helping Hand Council, No. 12, meets every Tuesday evening at the Hall, 2550 Emerald St. Chief Engineer, Edward Laurence. Corresponding Engineer, Frank McHugh, 2503 Tulip St. All correspondence should be addressed direct to the Council.

Municipal P. F. D. Council, No. 20, of Philadelphia, meets the second Thursday of each month at Odd Fellows' Hall, Third and Brown Sts. Chief Engineer, Daniel Bunting. Corresponding Engineer, Walter Meyers, 1211 North Howard St.

PITTSBURG.

Iron City Council, No. 21, meets every Saturday at Arnfeld Hall, 1119 Penn Ave. Chief Engineer, J. J. Stewart. Corresponding Engineer, Alex. Fraser, Carnegie, Pa.

GIRARDVILLE.

Girard Council, No. 8, meets every Tuesday evening at O'Neill's Hall, Second and Ogden Sts. Chief Engineer, Jacob Weber. Corresponding Engineer, M. J. Carey, Lock Box 214.

ALLENTOWN.

Lehigh Council, No. 15, meets every Wednesday evening at 639 Hamilton St. Chief Engineer, John evening at 639 Hamilton St. Chief Engineer, Henry C. Snyder. Corresponding Engineer, A. P. Driesbach, 728 Chew St.

POTTSTOWN.

Pottstown Council, No. 14, meets 1st and 3rd Saturday evenings at P. O. S. of A. Hall, Cor. High and Hanover Sts. Chief Engineer, Chas. Quinter. Corresponding Engineer, H. L. Shirey, 362 Cherry St.

READING.

Progress Council, No. 13, meets every Saturday evening at Diebert Hall, Ninth and Penn Sts., Room 4. Chief Engineer, John Kellenberger. Corresponding Engineer, Frank S. Miller, 3 West Franklin St.

CHESTER.

Delaware County Council, No. 6, meets every Wednesday evening in the Carpenter Hall, Sixth and Wall Sts. Chief Engineer, John Canavan. Corresponding Engineer, E. B. McCoy, 2222 West Third St.

YORK.

York Council, No. 16, meets every Wednesday Evening in the Jordan Block. Chief Engineer, A. L. Bair. Corresponding Engineer, Walter H. Long, 23 East Philadelphia St.

HARRISBURG.

Capitol City Council, No. 17, meets every Tuesday evening in Red Men's Hall, Market St., above Second. Chief Engineer, B. H. Shafer. Corresponding Engineer, S. Filson, 1126 Market St.

COLUMBIA.

Columbia Council, No. 18, meets every 1st and 3rd Saturdays, in Odd Fellows' Hall. Chief Engineer, John McLane. Corresponding Engineer, W. J. Courtney, 804 Walnut St.

SUNBURY.

Sunbury Council, No. 19, meets every Monday evening in Zartman's Hall. Chief Engineer, R. D. Mantz. Corresponding Engineer, Ed. Schrieber.

WISCONSIN.

Deputy Supreme Chief Engineer, Joseph P. Harris, No. 1611 Clybourn St., Milwaukee.

MILWAUKEE.

Washington Council, No. 1, meets every Saturday at 207 Grand Ave. Chief Engineer, J. B. Chambers. Corresponding Engineer, James A. Rigby, 136 Reed St.

Clifford P. Williams Council, No. 2, meets every Monday evening at Lodge Hall, E. Water St. Chief Engineer, J. T. Harris. Corresponding Engineer, Joseph T. Harris, 1611 Clybourn St.

TENNESSEE.

Deputy Supreme Chief Engineer, John B. Mullen, 826 Central Ave., Nashville.

NASHVILLE.

Enterprise Council, No. 1, meets every Friday evening in the Twin Building on Cedar St. Chief Engineer, J. J. Johnson. Corresponding Engineer, Jno. B. Mullen, 209 Jackson Building.

OREGON.

Deputy Supreme Chief Engineer, Nat. Freese, Grant's Pass, Oregon.

GRANT'S PASS.

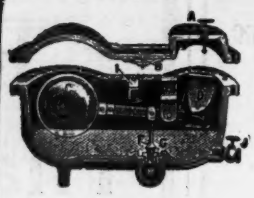
Oregon Council, No. 1, meets every 1st and 3rd Saturday in A. O. U. W. Hall, Main St. Chief Engineer, William H. Kenny. Corresponding Engineer, Nat Freese.

TEXAS.

Deputy Supreme Chief Engineer, S. A. Bisbey, care of Cotton Compress and Warehouse Co., Galveston.

GALVESTON.

Galveston Council, No. 1, meets every 2nd and 4th Tuesday evenings at Engineers' Hall, S. W. Cor. Twenty-second and Strand Sts. Chief Engineer, Max Levy. Corresponding Engineer, A. L. Bradford, Union Depot.



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Always have a Water Seal over the valve and never blow steam; neither do they back up water

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EXHAUST PIPE HEADS,
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GREASE EXTRACTORS,
STEAM SEPARATORS, etc.

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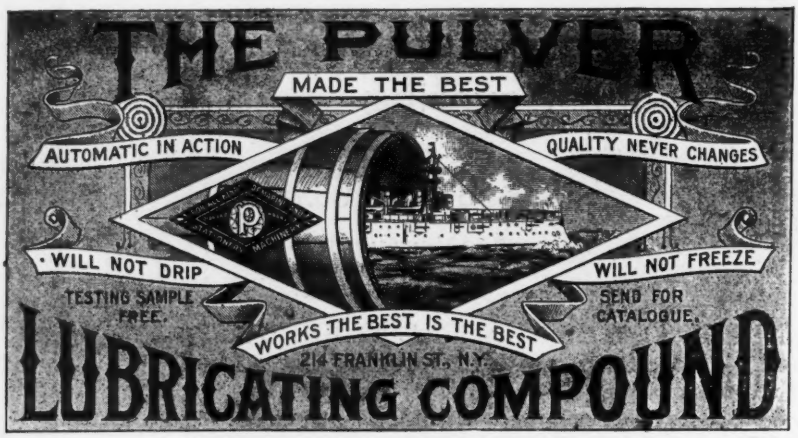

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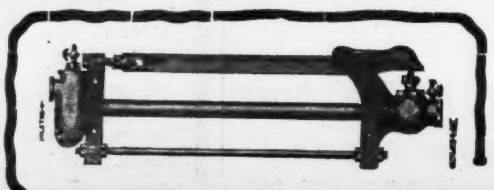

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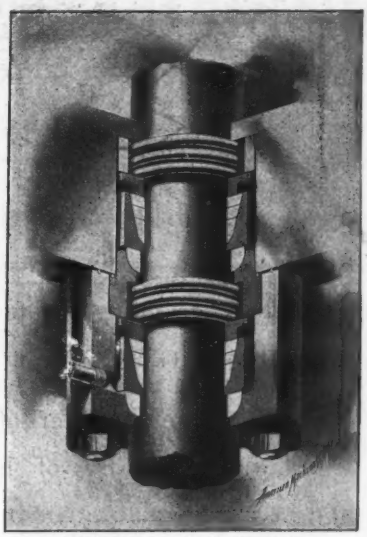

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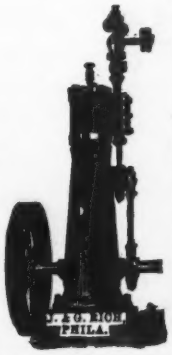

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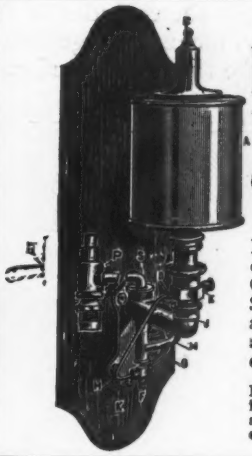

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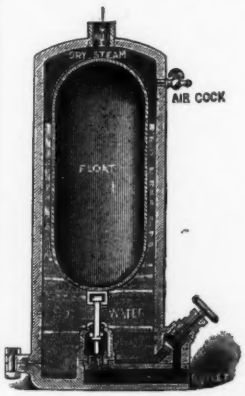

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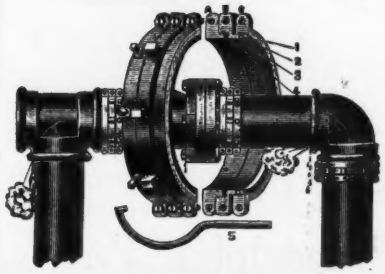

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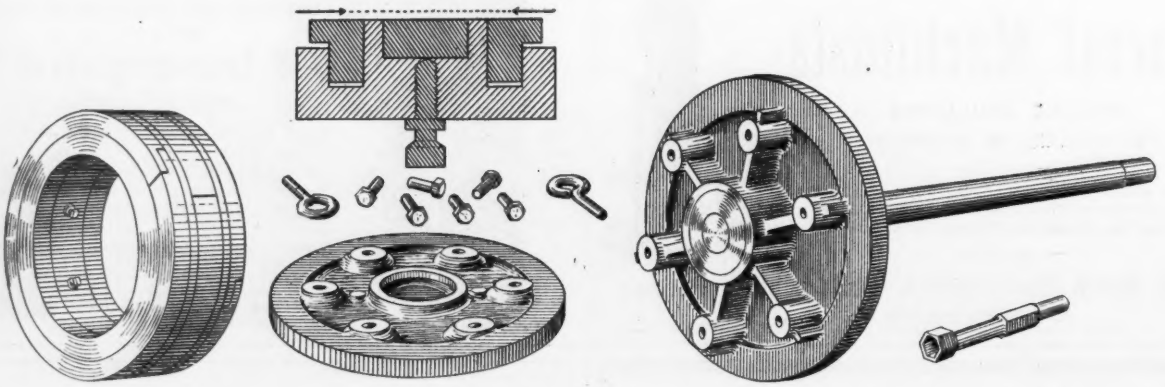

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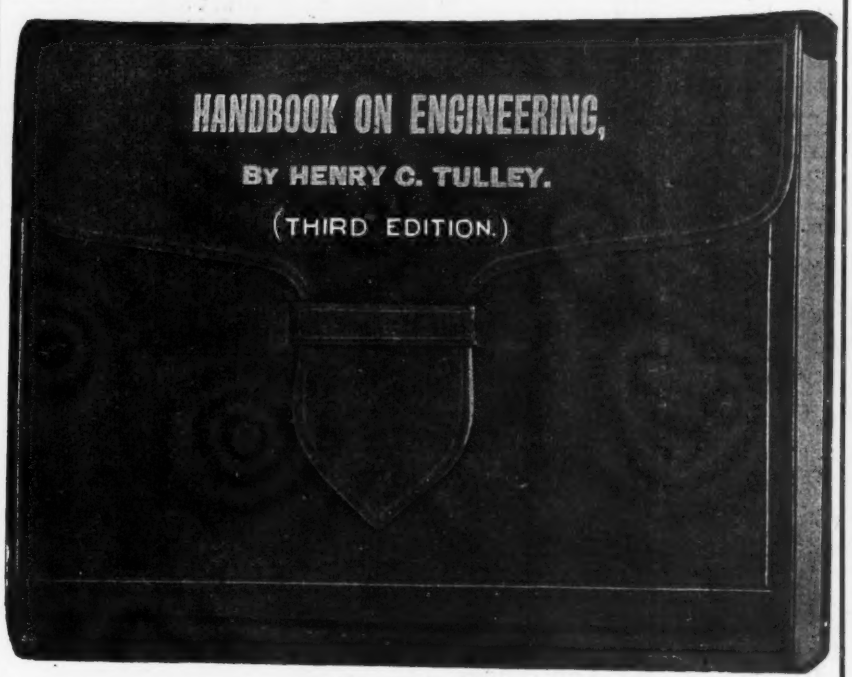

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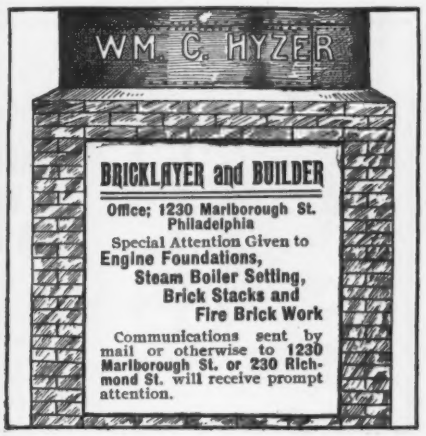
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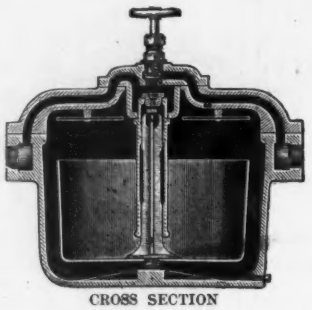

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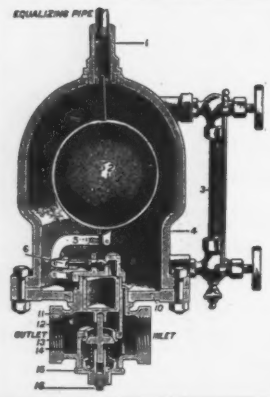

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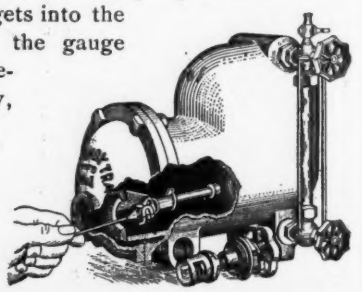

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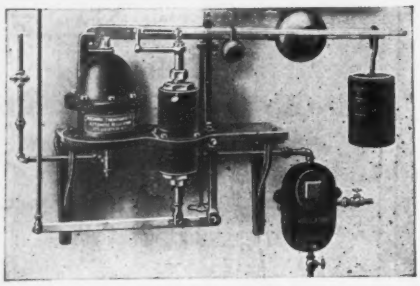

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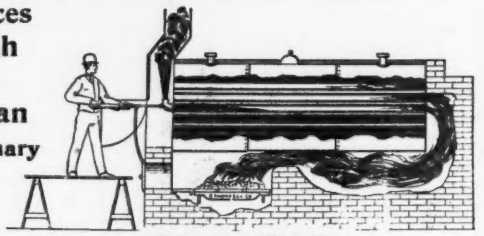

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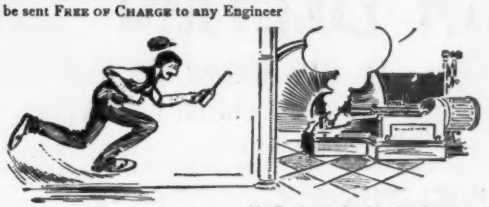

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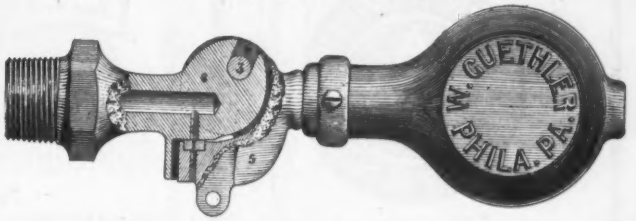

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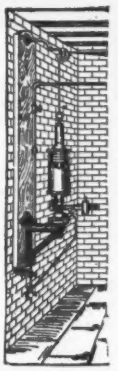

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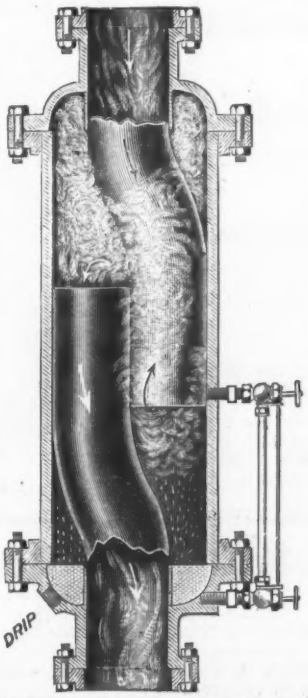

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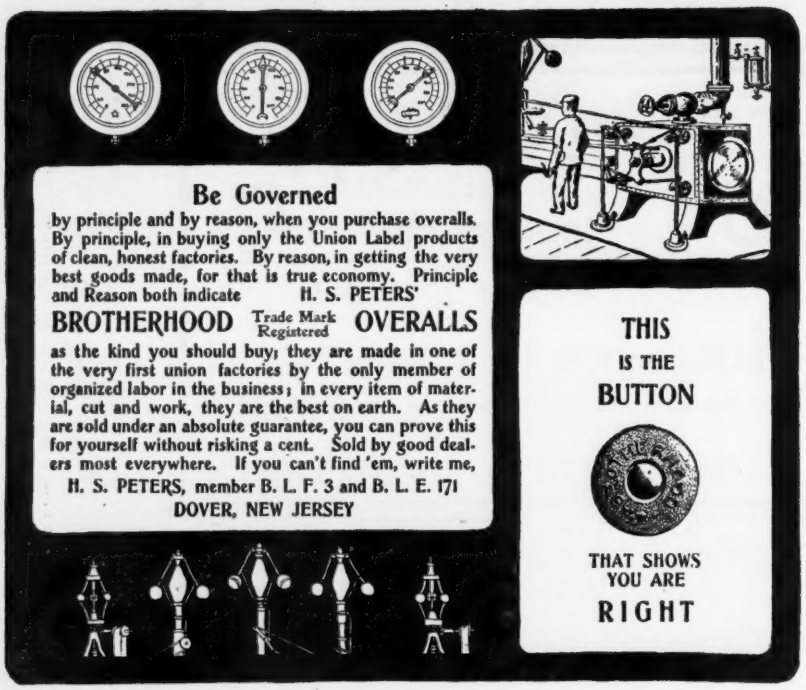

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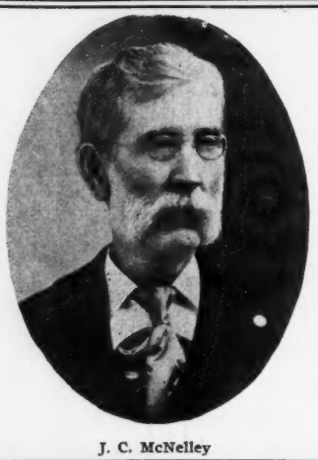

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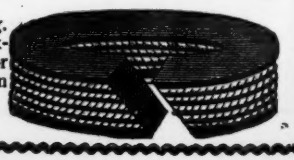

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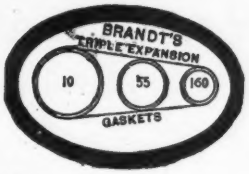

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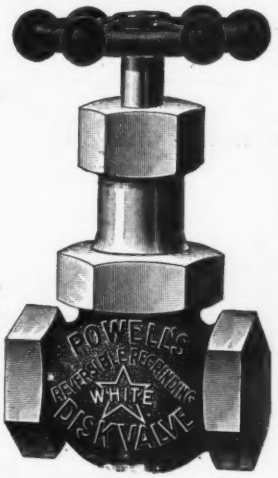

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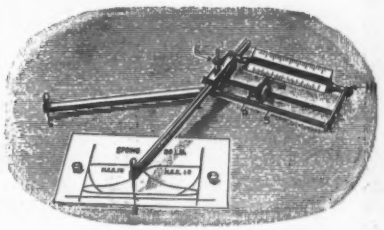

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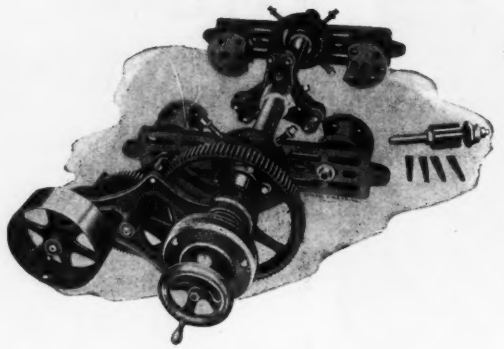

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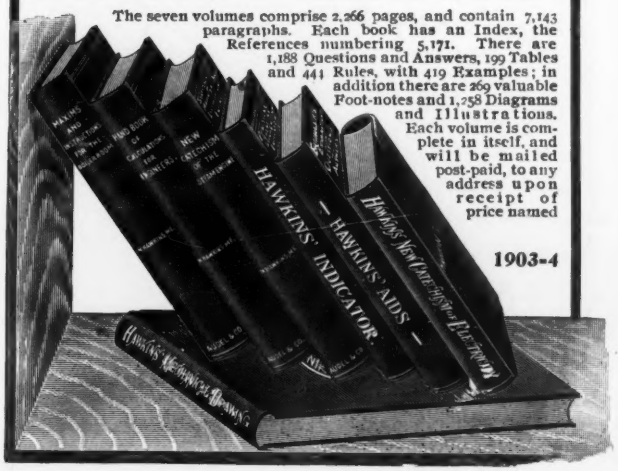

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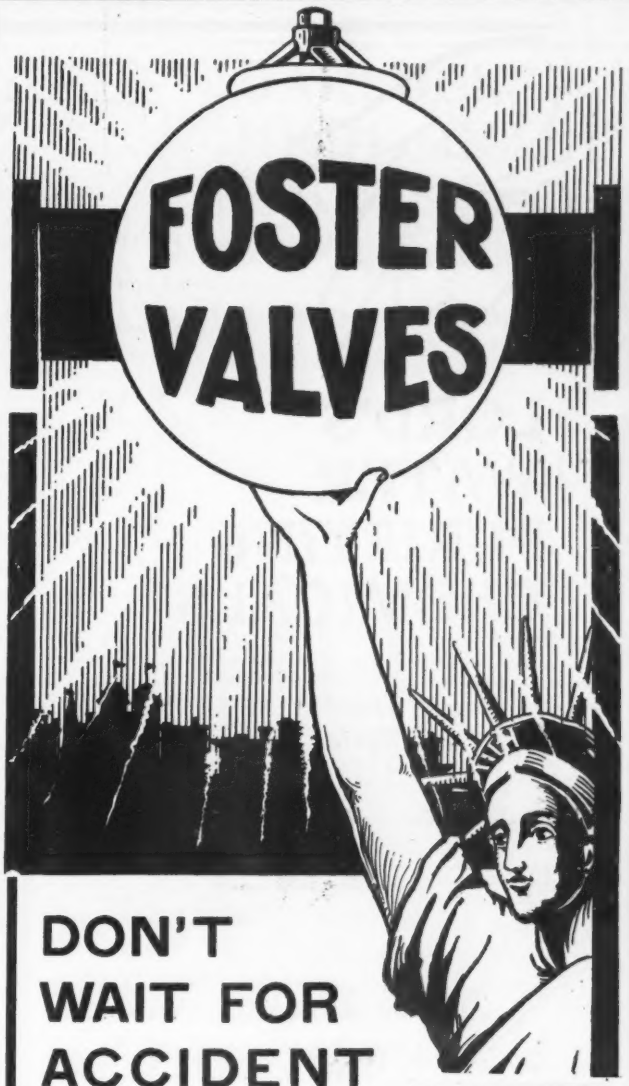

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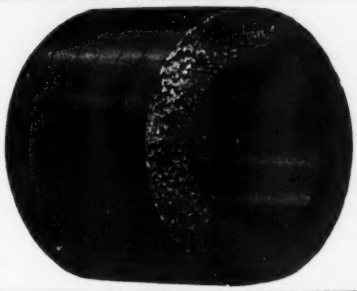

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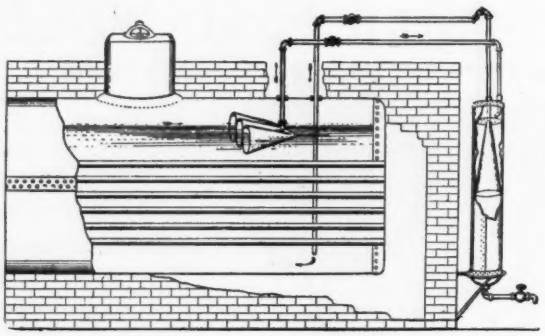

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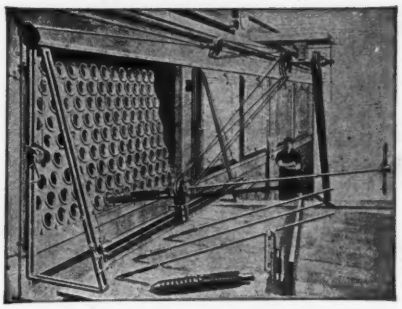

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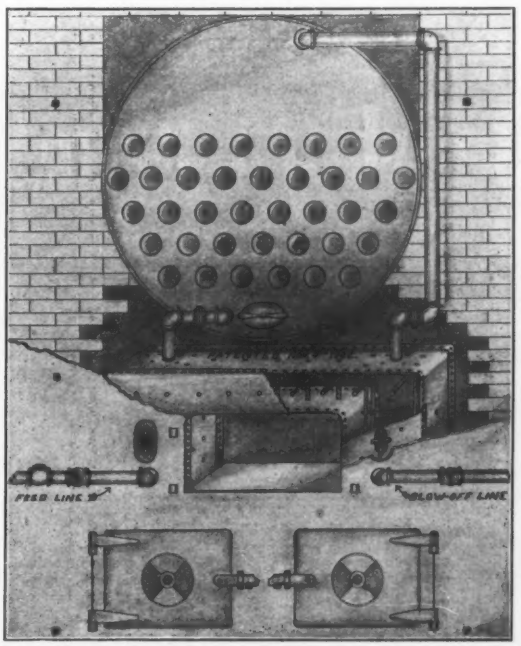

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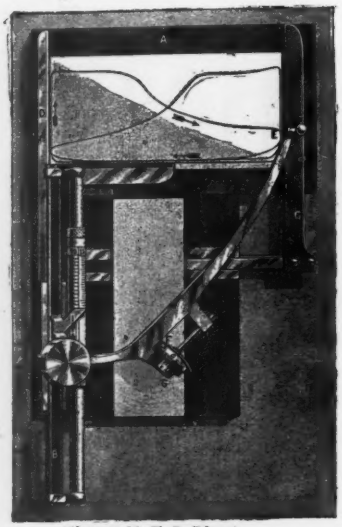

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Takes up the slack cord and puts it back where it belongs at the proper time.
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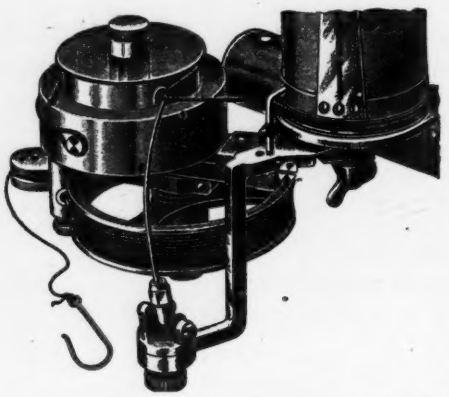

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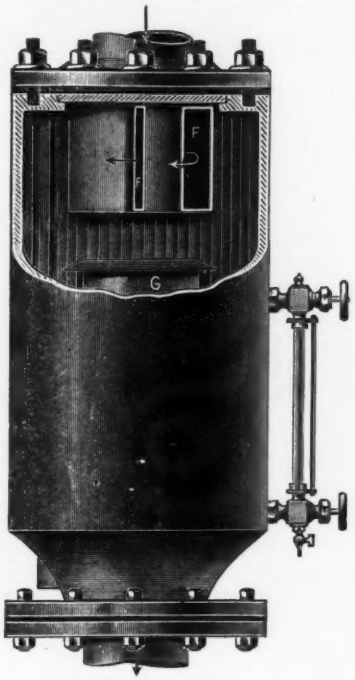

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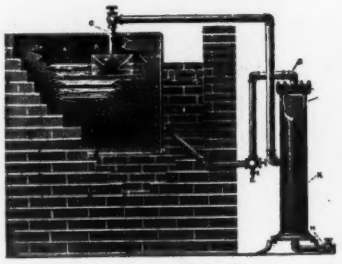

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Flue Blowers, Etc.

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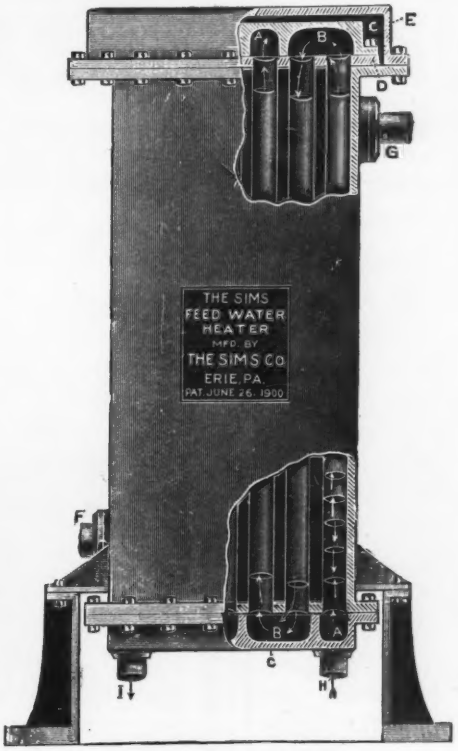
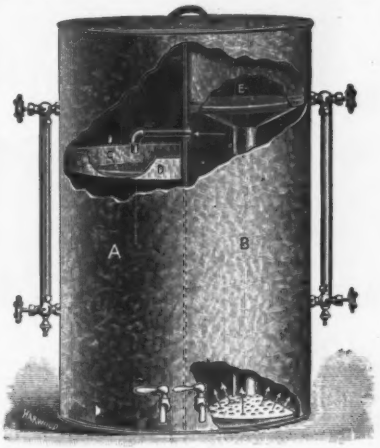


VERTICAL HEATER

The only feed water heater that has perfect circulation of feed water through every tube at the same time, constructed so the tube can be readily scraped.

This is the Oil Filter you require if you want the best results at lowest cost—

The "SIMS" Filter



PATENTED

The "SIMS" Low Water Alarm

A SAMPLE ORDER AFTER MONTHS OF COMPETITION WITH OTHER ALARMS

ELLSWORTH, PA., Sept. 5th, 1903.

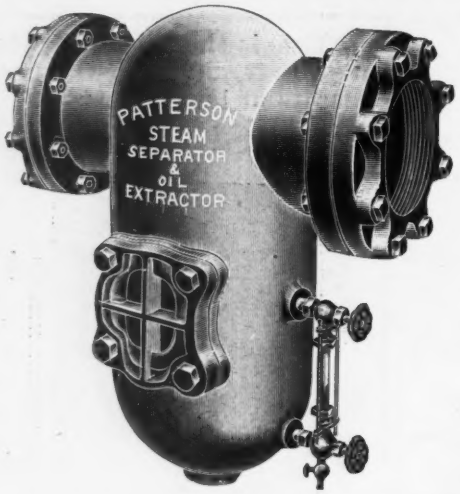
THE SIMS CO., Erie, Pa.,
Gentlemen:—

We have tested your alarms and find same quite satisfactory, and enclose herewith an order for thirty (30). You understand that you have to furnish us with (29) more and render us the bill for the whole thirty. We shall be glad if you will dispatch the same as soon as possible.

And oblige yours truly
JAMES W. ELLSWORTH & Co.

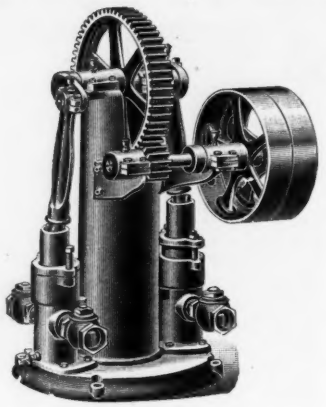
PATTERSON Steam Specialties

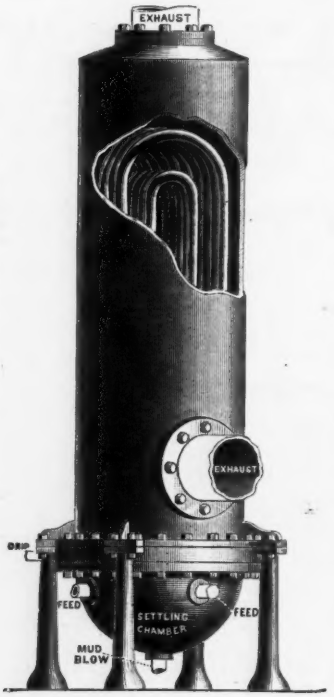
Are All Sold on Thirty Days' Trial, to Be Returned at Our Expense if Unsatisfactory



The interior construction and operation of our separators are described on page 26 of this issue of THE PRACTICAL ENGINEER, but we can't help again reminding you of that large hand hole for inspection and cleaning without disconnecting the pipes.

DID you ever consider how extravagantly steam pumps use steam? The power required to run a belt pump would hardly be missed. These are simple, strong and very reasonable in price.





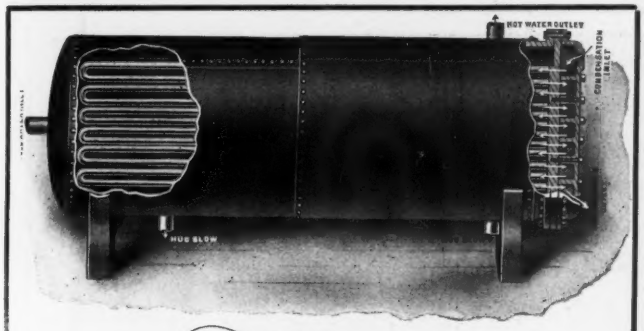
The sales of the Patterson-Berryman Feed Water Heater and Purifier keep right on increasing.

It's the old stand-by. No oil in the boilers, no trouble of any kind. You can't afford to experiment, even if the other fellow's is a little bit cheaper (at first) than this famous little fuel saver.

Are you tired of the way that exhaust pipe is spattering greasy water over everything, including your clothes? Perhaps the neighbors are, too. If a Patterson Exhaust Head won't stop the trouble, don't pay us a cent for it.

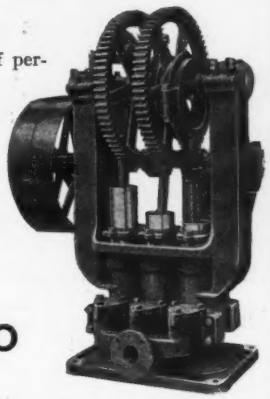
Frank L. Patterson & Co.

24 Cortlandt Street, New York



THE GLEANER
TRADE MARK

The **Gleaner** represents the acme of perfection in feed water heating.



The Davis Triplex Power Pump

is a perfect type of the vertical triplex belt driven pump.

Manufacturers of
The "Berryman" Feed Water Heater and Purifier

I. B. DAVIS & SON
HARTFORD, CONN.

WRITE FOR CATALOGUE, ETC., TO

THOS. McADOO
125 NORTH 4TH ST.
PHILADELPHIA

The OTIS Tubular Feed Water Heater, Oil Separator and Purifier

with Seamless Brass Tubes

Guaranteed

To heat the feed water to the boiling point (210 or 212 degrees) with the exhaust steam without causing any back pressure, **also to extract the oil from the exhaust,** so that the exhaust steam after being passed through the heater can be used for heating purposes, and the water of condensation for the heating system be returned to the boiler without the additional expense of an eliminator.

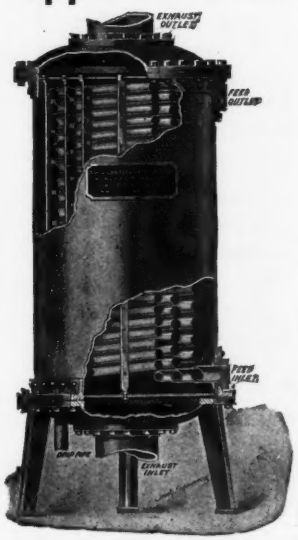
A Liberal Offer

If this heater fails to give satisfaction in every respect, we pay freight, cartage, etc., both ways.

The Stewart Heater Co.

11 Norfolk Ave., Buffalo, N. Y., U. S. A.

The American Standard Copper Coil Feed Water Heater



Simplicity!
Strength!
Economy!
A Money Saver!

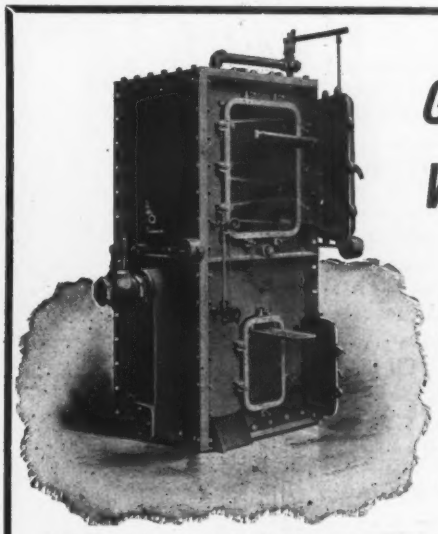
It gives so little trouble that one of our customers, who has used one for 8 years, had forgotten that he had it when we asked him the other day how it was doing. He called in the engineer, who said it hadn't been touched since it was put in and was still heating the water to 210 degrees.

That's the kind of a Heater you want.

Write for Catalogue No. 100 P.

The Whitlock Coil Pipe Co.

HARTFORD, CONN.



GOOD WORDS

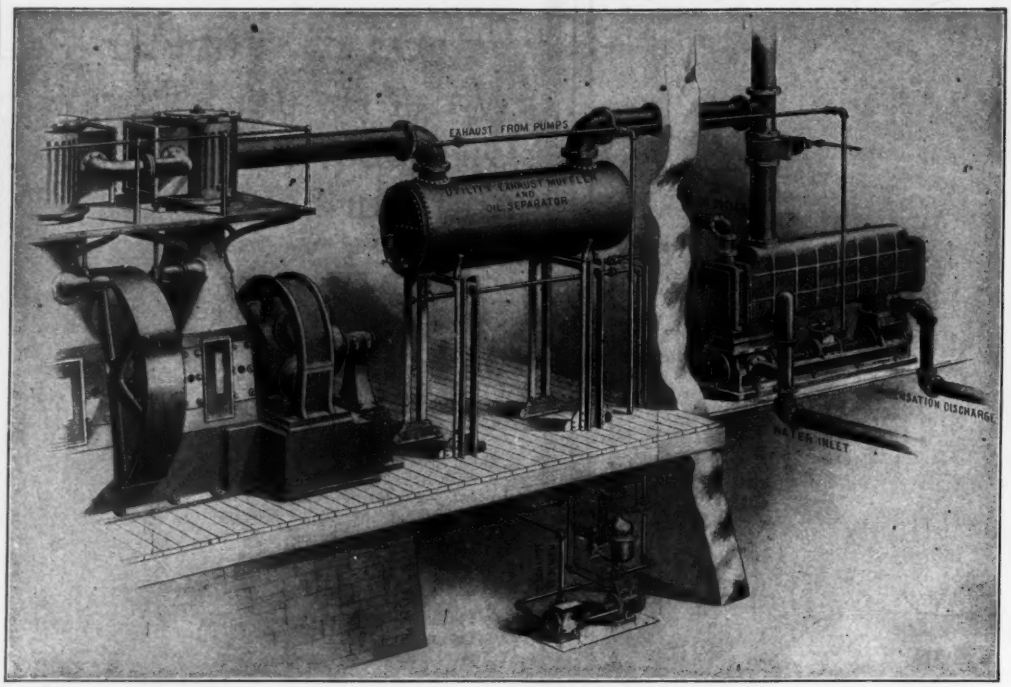
Nothing is more striking than the extent to which expert engineers recommend

WEBSTER FEED-WATER HEATERS AND PURIFIERS

Engineers must be cautious. Their reputations are easily injured. They cannot afford to recommend a heater unless it has been long and widely used, and thoroughly tested. A million and a quarter horse-power of Webster Heaters in use.

Warren Webster & Co.

CAMDEN, N. J.



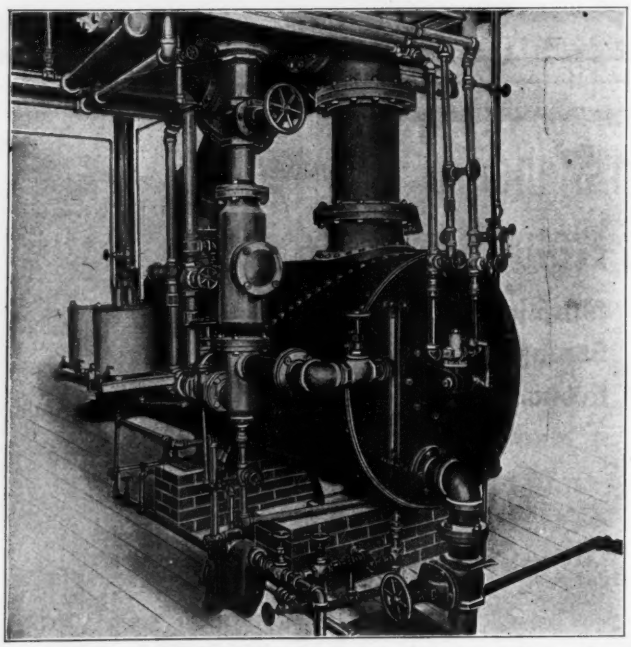
HOW IS THIS FOR A TEST OF OIL SEPARATION UNDER A VACUUM? SIZE No. 5 "UTILITY."

A TEST MADE BY F. R. HUTTON M. E., Feeding Double THE USUAL QUANTITY OF OIL, SHOWED AN EXTRACTION OF 99. 9992/10000%

Exhaust Muffler and Oil Separator as Installed in a Condensing Engine Plant.

We **GUARANTEE** the **"UTILITY"** the **BEST OIL SEPARATOR** on the market, either for condensing or non-condensing work, and it is **SELF-CLEANING**. Installed in your **MAIN** exhaust pipe we **GUARANTEE** you can return to your boilers all exhaust condensation and we will keep your boilers and heating system **ABSOLUTELY** free from **OIL**.

The **"UTILITY"** Feed Water Heater is simple in construction, requires no floor space, and heats the boiler water to 212 degrees.



Our **GUARANTEE** is based on the **CHEMICAL ANALYSIS** of the condensed exhaust steam **BEFORE** and **AFTER** passing through our device **WHICH IS POSITIVE PROOF.** We were the first on the market to show such a test and are always pleased to do it in any of the hundreds of **"UTILITY"** installations.

Send for booklet of testimonials. **Our customers talk for us.**

Our prices will interest you.

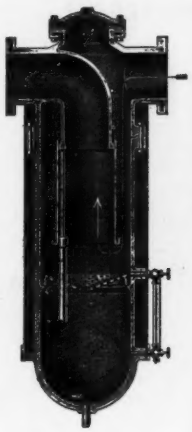
Exhaust Muffler, Oil Separator, Return Tank, Pump Governor and Feed Water Heater as Installed in a Non-Condensing Engine Plant.

THE STANDARD STEAM SPECIALTY CO.

Steam Specialties

542-544 West Broadway, CITY OF NEW YORK.

Philadelphia Agent, R. M. HUSTON, M. E., 204 South Third Street



SWEETS . . . SEPARATORS

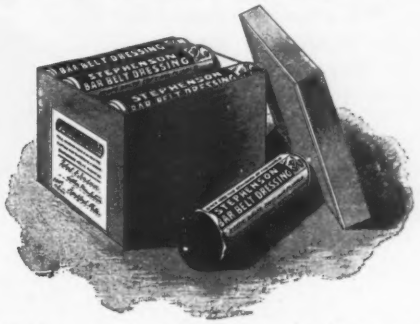
When you are told a separator takes oil and water from the steam current, *find out* where *it goes* and *what separates it*, that it will hold a lot of water, look up the weight and dimensions; that it's well finished, ask what covers it and where the work on it is, then send for our printed matter and put the stories together. We make all styles, for steam or oil, also **Exhaust Heads and Steam Traps.**

DIRECT SEPARATOR CO.
220 Marcellus St., SYRACUSE, NEW YORK
R. S. SPENCER, Philadelphia Representative, 1218 FILBERT ST.

BELT TALK

SOME MEN lace their belt so tight that it is weakened, the lacing holes tear out and their shaft is bent, just to keep it from slipping, and still it slips.

OTHER MEN use Stephenson Bar Belt Dressing and let the belt run loose, gain 25 per cent. in power, 50 per cent. in the life of the belt, keep the shaft as true as a die, and have no breakdowns.



SOME MEN say, "I don't believe such talk," and go right on wasting good belts and losing valuable power.

OTHER MEN accept our offer to send a Testing Sample Bar Free, and then are convinced. We would like to send you a testing sample bar by mail, postage paid. TRY US ONCE.

Stephenson Mfg. Co., ALBANY New York

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THE BAUM SEPARATOR

For Live and Exhaust Steam

Horizontal Style for Live Steam or Oil Service

RESULTS GUARANTEED

For condensing systems use the BAUM VACUUM STYLE OIL EXTRACTOR.

Most Satisfactory Separator on the market. *Ask why.*

Vacuum Style Oil Extractor

The Baum Separator and Machine Company
READING, PA., U. S. A.
Philadelphia Agents, AMERICAN SUPPLY CO., 612 Betz Building

BERRYMAN

Feed Water Heaters and Purifiers

WATER-TUBE AND STEAM-TUBE

Cast Iron or Steel Shells. "∩" Shaped Seamless Drawn Brass Tubes

WE BUILD HEATERS FOR EVERY PURPOSE AND CONDITION

THE KELLEY PATENT
Improved Berryman Water Tube Feed Water Heater and Purifier

A thoroughly up-to-date, reliable and efficient heater Made to stand the highest pressure; and so constructed as to be utterly indestructible by the heaviest boiler it is possible to carry. Write for catalogue.

We have a few good heaters, second-hand, which we will sell cheap, ranging from 50 H. P. to 1000 H. P. Mostly taken in trade for our Improved Berryman water tube Feed Water Heater and Purifier. Every heater is **Tested and Guaranteed.**

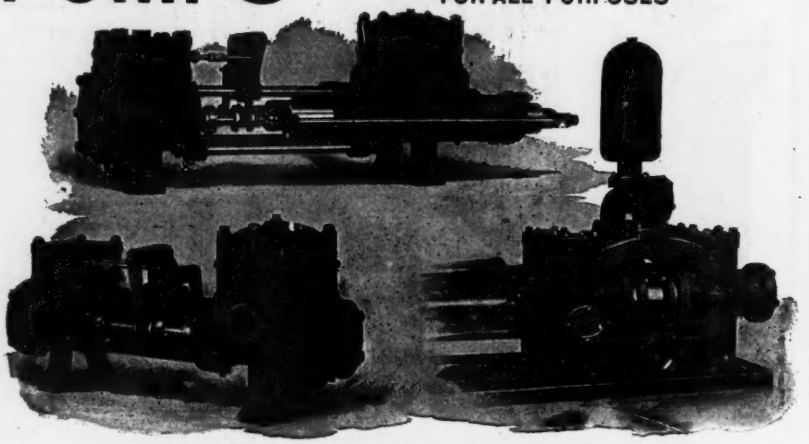
BENJ. F. KELLEY & SON, Makers
91 Liberty Street, New York

The Tornado Boiler Tube Cleaner

Requires LESS steam than any other cleaner.
Will positively clean BETTER than scraper or brush.
Will clean ANY length tube.
In operation is EQUALLY balanced, insuring NO back pressure against operator.
Is the LIGHTEST and EASIEST cleaner to handle.
Has NO working parts.
Its force is tremendous.

MANUFACTURED BY
PAUL B. HUYETTE
1245 Betz Building, PHILADELPHIA

PUMPS Steam, Belt or Electric Power
FOR ALL PURPOSES



BARR PUMPING ENGINE CO.
NOT IN THE TRUST
WORKS, GERMANTOWN JUNCTION
CITY OFFICE, 55 N. 7TH ST., PHILADELPHIA

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A THOROUGHLY UP-TO-DATE SHAKING GRATE FOR PARTICULAR ENGINEERS. WRITE FOR CATALOGUE.

THE KUTZTOWN FOUNDRY AND MACHINE COMPANY
MAKERS OF HIGH GRADE
Boiler Fronts, Grate Bars, Furnace Castings, Compound Separators, and General Boiler Castings

Works: KUTZTOWN, Penna.
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STEAM FITTING
if not properly done, in any plant, will cause the engineer a great deal of trouble, and his employer unnecessary expense. Many years of practical experience and a force of competent assistants enables me to guarantee absolute satisfaction.
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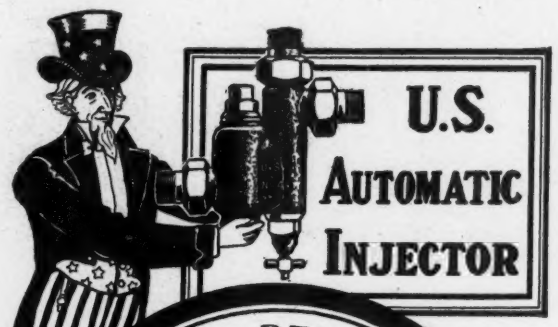
JOBBING A SPECIALTY

GARLOCK
HYDRAULIC LEATHER CUP
has been given the hardest tests, and pronounced by hydraulic engineers to be the strongest and smoothest on the market.
Send us a trial order, and if you don't find them right return them at our expense. They are made of pure oak tanned leather in natural color.
GARLOCK PACKING CO.
604 ARCH STREET, PHILADELPHIA

General Engineering and Repairing. Reboring Cylinders in Present Position from 3-110 in. Dia., and Turning off Dynamo Commutators without removal.

CAST IRON GRATE BARS
SECOND-HAND TANKS
PHONE 5-27-78



U.S. AUTOMATIC INJECTOR

EASY REPAIRS

You don't have to send the **U. S. Automatic Injector** to us for repairs if any of the parts should become worn.

Each part is interchangeable, and you can replace it yourself.

The Delivery Tube and Suction Jet are the parts most liable to wear, and if you order a duplicate of each when buying the Injector you will save a lot of time.

Our "Engineer' Red Book" tells all about this, and it is free for the asking.

AMERICAN INJECTOR CO.
Detroit, Mich.

Made in the United States

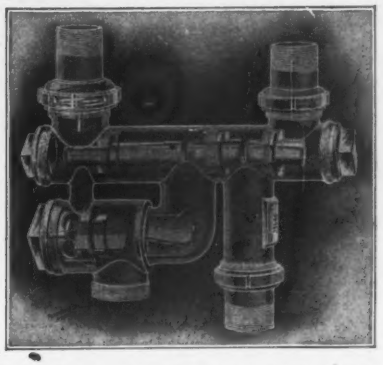
Used the World over

AN UP-TO-DATE BOILER FEEDER
FOR MODERN STEAM PLANTS

The AUTO-POSITIVE

TRADE PENBERTHY MARK.

High Pressure Hot Water Restarting Injector



Is a great advance in injector construction.

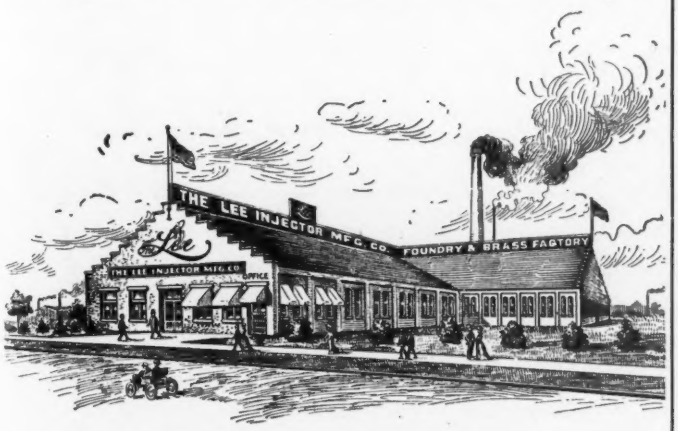
Range 20 to 200 Lbs. Steam

Handles Hot Water at 140 Degrees

Only Five Working Parts

PENBERTHY INJECTOR CO.
DETROIT, MICH.
Largest Injector Manufacturers in the World.

Progression in Quantity and Quality



HERE IS WHERE WE WILL DO IT

We will strive to advance the character of our goods

ALWAYS BUY THE BEST

EVERYTHING GUARANTEED

Send for Catalogue

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SOUTH PARK, PORT HURON, MICH.

All in the Water Column

Try Cocks, Sight Glass
Alarm Whistle and
Automatic Feed Control

HALF THE USUAL PRICE

Saves your Boiler
Saves your Engine
Saves your Fireman
Saves your Money
and May Save your Life

Write for Catalogue

BERRY ENGINEERING CO., Chester, Pa.

Belting is a large item of expense to all power plants, especially when used in exposed places, subjected to extreme heat, water, chemical actions, etc. For this reason we have imported the **"Teon"** belt, which is made to resist exposure of all kinds. Being light in weight, and having enormous strength and a splendid driving surface, it will transmit more power than any other belt known. No ingredient used in **"Teon"** is influenced by less than **230 degrees Fahrenheit; this is 18 degrees above boiling**

"Teon" is **water-proof** and effectually repels the action of caustic soda, ammonia and other chemicals. Every belt is passed through a specially devised stretching apparatus, which insures a sound, reliable and high grade belt.

For all outdoor drives, all severe conditions and varying loads.

THE "TEON" BELT

Will work where others will and will work where others will not.

Some trades and uses where "Teon" is especially suitable:

Dyehouses	Tanneries	Wool Drying Machines	Jute Mills	Cotton Mills
Brick Making Plant	Glass Works (Bevelling and Polishing)	Dynamos	Breweries	Flour and Grain Mills
Cement Works	Wet Spinning	Briquette Making Machines	Tea Factories	Paper and Pulp Mills
Oil Mills	Engineering Works	Drying Rooms and Hot Closets	Laundries	Agricultural work
Disintegrators	Textile Manufactories	Cocoa and Chocolate Works	Bleach Works	Grinding Machinery
Oil Cake Mills	Mines and all Subterranean Work	Coal and Other Conveyor and Elevator Plant	Stamp Batteries	
Rice Mills	Timber and Saw Mills	Hot Malt Conveyors	Portable Engines	
Chemical Works	Finishing Works	Fan Driving	Foundry Blowers	
Print Works.				

"TEON" THE LEADING FAN DRIVER

Every belt is sold with the GUARANTEE that if it is not as represented in all respects, we will REFUND the money.

D. P. BROWN & COMPANY

Sole Importers United States Agents

262 and 264 N. 4th Street

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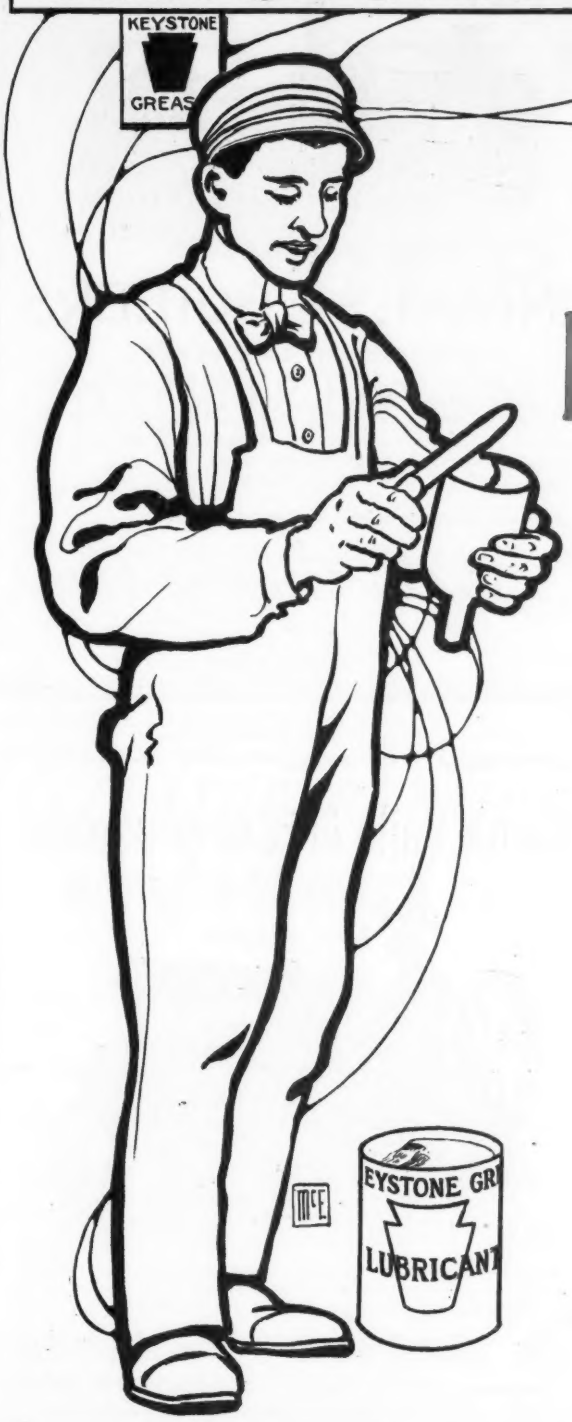
PENNA.

Oil Proof Ring Packing with Imported Compound Cushion and Special Metallic Protection.

Imported Oil Proof Non-Vulcanizing Sheet Packing.

Brown's Universal Spring Steel Packing Hooks (six in a box) will fit in any box

KEYSTONE GREASE



A STANDARD RULE

"The Best is always the Cheapest."

Keystone Grease

is the most reliable and by far the cheapest lubricant for machinery in the world.

This is a broad statement, nevertheless it is true.

The process of manufacturing **Keystone Grease** is such that a perfectly natural body is obtained without having recourse to the use of beeswax, tallow, talc, resinous oils, or any of the substances so commonly found in other greases.

Tested and tried, **Keystone Grease** has invariably given results that lead us to make the claim, that one pound of **Keystone Grease** will reduce friction lower, and last longer than four gallons of high grade lubricating oil or from three to five pounds of any other grease or compound made.

We will put a little of our money up against a little time of any engineer to prove this claim, therefore any engineer sending us his name and business address will receive FREE EXPRESS PAID a large can for testing purposes, and a heavy well-finished brass grease cup ABSOLUTELY FREE with no strings attached.

LUBRICANT
TRADE MARK REGISTERED

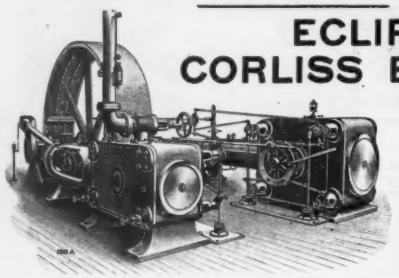
Keystone Lubricating Co.

20th St. and Allegheny Ave. - - PHILADELPHIA

FRICK COMPANY

ENGINEERS

WAYNESBORO, FRANKLIN CO., PA.



ECLIPSE CORLISS ENGINES

Plain Corliss Engines, Cross and Tandem Compound, Vertical Corliss Engines.

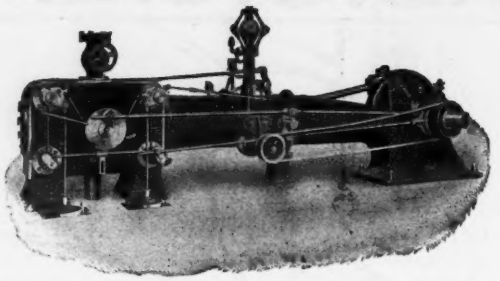
Corliss Engines of any type, 40 to 2000 horse-power, specially adapted for electric railway work and lighting for factories, mills and general work. Best regulation and economy guaranteed. Also builders of Steam Boilers. We solicit the furnishing of steam plants complete, including everything. Send for our **Corliss Engine Pamphlet** and list of references.

ICE MAKING AND REFRIGERATING MACHINERY

We furnish complete plants for ice-making and refrigeration for Breweries, Packing Houses, Cold Storage, etc. All refrigerating capacities, from 2 to 800 tons; ice-making plants from 1 to 1000 tons per day. We publish a book describing Ice Making and Refrigeration, which will be sent to intending purchasers.

NEW YORK OFFICE: Taylor Bldg, 39-41 Cortlandt St.

ATLAS



ENGINES AND BOILERS

SATISFACTORY EXPERIENCE

FAYETTE, OHIO, Aug. 9, 1903.

ATLAS ENGINE WORKS, Indianapolis, Ind.

DEAR SIRS:—My experience with your engines has been quite extensive and they have been very satisfactory to me, and would be pleased to recommend them at any time.

Yours very respectfully,

R. M. COLLINS.

CATALOGUES ON REQUEST

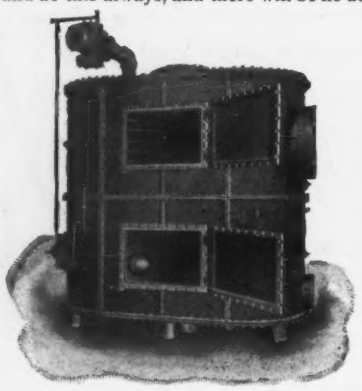
Atlas Engine Works.

Dep't P. *Indianapolis.*

The Stilwell Heater

will use your exhaust steam and furnish pure hot water for your steam boilers.

It will heat your water as hot as the exhaust can make it, and do this always, and there will be no deterioration in heating efficiency because of age or because some one has forgotten to clean it.



It will give all the purification obtainable with exhaust steam, saving the exhaust in doing the heating, saving the returns and live steam drips and giving purification in other ways.

There are other advantages derived from the use of this Heater, fully explained in our catalog.

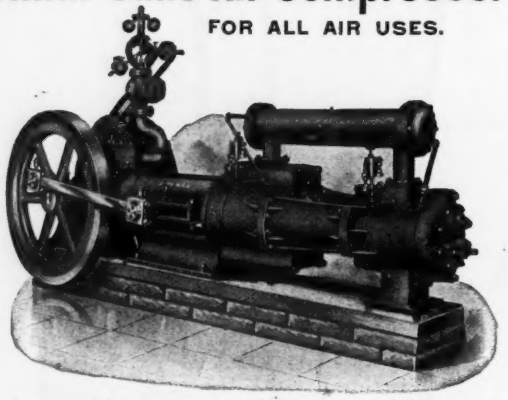
The Stilwell-Bierce & Smith-Vaile Co.

DAYTON, OHIO.

PHILADELPHIA: 619 ARCH STREET.

Smith-Vaile Air Compressors

FOR ALL AIR USES.



Made in straight line and Duplex types; single and multiple stage Compression; steam or belt driven.

If interested, write

The Stilwell-Bierce & Smith-Vaile Co.

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San Francisco, 11 and 13 First St.
Chicago, 311 Dearborn St.
Cleveland, 1116 New England Bldg.
Pittsburg, Smith Block.
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Baltimore, 1507 Continental Trust Bldg.
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WE ALSO MAKE

Steam and Power Pumps for all purposes, Condensers, Stilwell's Feed Water Heaters, and Victor Turbine Water Wheels.

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HAVE YOUR

ELEVATORS

REPAIRED

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Keystone Elevator Inspection and Repair Co.

Removed to **923 Locust Street, Philadelphia**

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We Carry Repair Parts in Stock, and Will Work Holidays and Nights When Necessary

ESTIMATES ON NEW WORK

ELEVATOR REPAIRS

MORSE, WILLIAMS & CO.

PHILADELPHIA

We have the largest and most complete Elevator Plant in Philadelphia, also a down-town storeroom, and skilled mechanics, especially for Repair Work.

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Passenger and Freight Elevators

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AIR CUSHIONS, Automatic Car-Locking Devices, Mechanical and Electrical Indicators, Automatic Door Mechanism, Steam and Power Pumps, Electrical Annunciators, Safety Gates, Air Pumps, Air Tanks, Pressure Regulators, Etc.

Repairs and Alterations of Elevator Plants
A SPECIALTY

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FRANCE METALLIC PACKING

The Ring that made this Packing famous.

For Steam

It is used everywhere and we have no complaints.

For Ammonia

rods, only a few have tried it, but those few are ready to swear by it.

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SEARCHLIGHT PACKING

WHITE SHEET

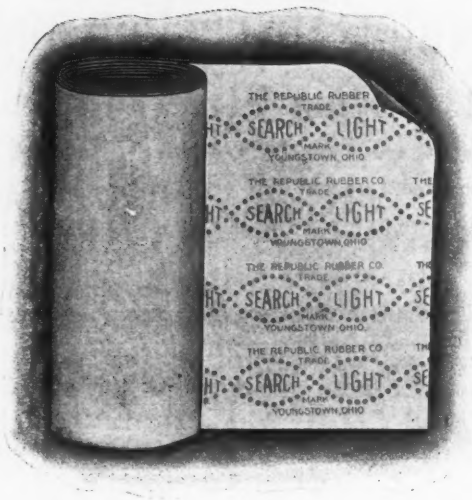
THE BANNER PACKING OF THE WORLD

Vulcanized under 500° of heat in process of manufacture . .

To the Engineering World

SEARCHLIGHT
IS SUPERIOR TO ANY OTHER SHEET PACKING on the globe. WE WILL PROVE THIS TO YOU on any chemical, steam or pressure test that you desire.

YOU ARE THE ONES TO JUDGE
THE MERIT of one packing over that of another.



CLAIMS
WILL NOT MAKE YOUR STEAM JOINTS TIGHT.

MAKE A JOINT OF SEARCHLIGHT
alongside of the packing you are now using.

DEMONSTRATE TO YOUR OWN SATISFACTION
whether or not it will give you what we claim—better results than you have heretofore secured.

Having been subjected in manufacture to a much greater degree of heat than it will ever meet in a steam joint

SEARCHLIGHT CANNOT HARDEN IN SERVICE

PATENTED AND MAN

THE REPUBLIC R

YOUNGSTOWN O

MULCONROY COMPANY, Incorporated 121

Agents for PH

CROSS ARM TUBULAR GASKET

WIRE INSERTION—COPPER JOINT

Made from SEARCHLIGHT PACKING COMPOUND combined with a BRASS WIRE MESH INSERTION, the ends being united by means of a SPECIALLY ANNEALED COPPER SLEEVE

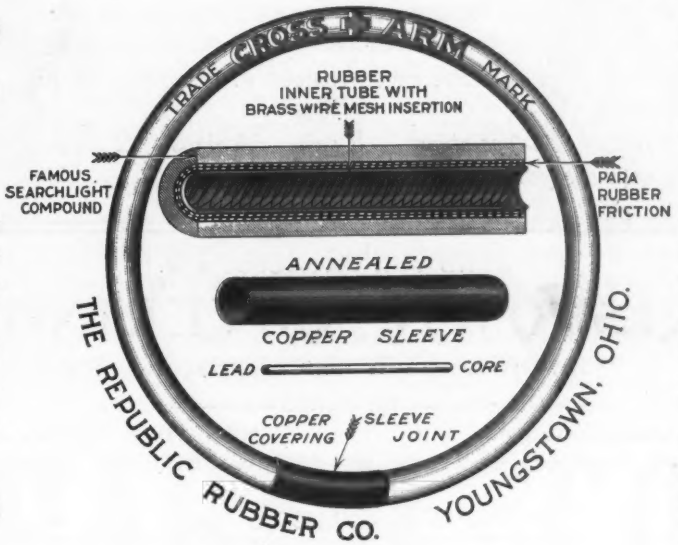
A PERFECT COMBINATION

NOTE ITS CONSTRUCTION

OF RUBBER, BRASS, WIRE, LEAD AND COPPER

A Brass Wire Mesh Runs Through the Centre

of the Gasket, and when Heat and Pressure are applied the Wire is imbedded into the Rubber, making THE ONLY THOROUGH BRASS WIRE INSERTED TUBULAR GASKET MANUFACTURED.



An Annealed Copper Vulcanizing Sleeve

is furnished TO COVER THE JOINT. This Sleeve is a specially prepared composition of Minerals and Copper so that when Heat is applied in connection with the Rubber IT VULCANIZES SOLID, FORMING A PERFECT GASKET WITHOUT BREAK OR JOINT.

Specify Cross Arm Gaskets

and Get the Genuine

Covered by United States Letters Patent No. 171,417

We will prosecute infringements to the law's extent

Our Trade Mark

Branded on Every Gasket

CROSS ARM—HIGH PRESSURE

MANUFACTURED SOLELY BY

RUBBER COMPANY

OHIO

1215 Market Street

PHILADELPHIA

Engineers of America

WE GREET YOU IN PRINT, as it is impossible for us to call upon all of you.

We feel interested in you, and if you will co-operate with us we can help you. Fill out the coupon at bottom of page and we will send you estimate of cost for covering your steam, water and brine pipes, or boilers and heaters, and we will tell you how much you can save, free of charge

You may ask, does it pay to have pipes covered? Read the editorial on page 15 of this issue and you will be convinced of the value of pipe coverings in general.

It saves fuel. It saves steam. It saves packings. It prevents condensation. It insures dry steam for your cylinder.

SEND FOR CATALOGUE E.

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Main Office and Works, Norristown, Pa.

BRANCHES

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FILL OUT THIS COUPON AND MAIL TO US—IT WILL PAY YOU

NORRISTOWN COVERING COMPANY, NORRISTOWN, PENNA.

Please give estimate for covering the following pipes and fittings:

NAME.....

ADDRESS.....

Steam Pressure .....

Are Pipes Cast or Wrought?.....

How Many Gate Valves?.....

Give size of different pipes and total number of fittings for each as follows:

SIZE	FEET	ELLS	TEES	VALVES	CROSSES

If covering is wanted for Boilers, Domes or Heaters, please state whether block or cement covering is preferred, and give circumference of, and length or height of each, as follows:

Distance Around Boiler .....

Length of Boiler.....

Distance Around Heater.....

Length of Heater.....

Distance Around Dome.....

Height of Dome.....

Any engineer can apply our coverings or cement—we s nd full instructions with every order.

The LUNKENHEIMER "Handy" Gate and Lever Throttle VALVES

Are Unequaled in Places where Reliable QUICK-ACTING Valves are Required.

The "Handy," for pressures not exceeding 75 lbs., is made in sizes ranging from ½ inch to 4 inch in Brass; 2 inch to 8 inch in Iron, brass mounted; 1 inch to 8 inch in all Iron. The Lever Throttle Valve, for 175 lbs. pressure, is made in Brass, ¾ to 2½ inch; Iron Body, brass mounted, 2½ to 6 inch. These valves are made only in Screw Ends. Simple, practical low priced. Specify *Lunkenheimer* make and get the original and best. Supplied by dealers. Write for catalogue.

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STEAM, BRINE AND AMMONIA COVERING

WATER PIPE COVERING

Sheet Cork for Cold Storage Insulation

Cork Cement for all Irregular Surfaces
Boilers and Tanks

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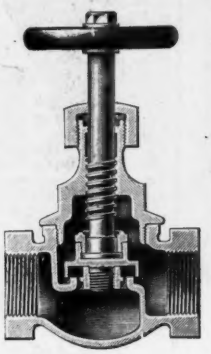
JENKINS BROS.' VALVES

are not constructed with metal against metal, and constantly having to be reground—thus soon wearing out valve—but are fitted with, and depend on the Jenkins Disc for making a perfectly tight seat. Our regular Jenkins Discs will withstand the action of high pressure steam, oils, acids, etc., while our soft discs are made expressly for water, gas and air service. Jenkins Bros.' Valves are the easiest and cheapest to keep in repair.



Brass, Screwed

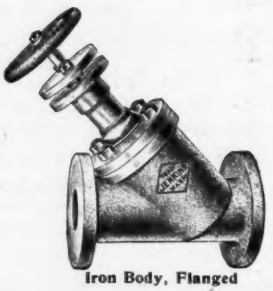
Jenkins Bros. "Y" or Blow-off Valves.

The construction is such that it has **no pocket,** or anything to obstruct the passage of steam or fluid. In closing it shuts against the pressure. Its internal arrangements are similar to those used in the regular

JENKINS BROS. GLOBE AND ANGLE VALVES.

It has no superior as a **blow-off valve,** and is especially adapted for use in **Paper Mills, Sugar Houses,** or any place where the *passage of a thick fluid* is required.

Iron Body, Screwed



Iron Body, Flanged

Jenkins '96 Packing

NONE BETTER,

As it makes joint instantly, and will last as long as the metals which hold it.

NONE CHEAPER,

As it weighs less than many others sold at equal price per pound.

It's the Perfection of Joint Packing

WRITE FOR "POINTS ON PACKING."

Pump Valves

We make different grades suitable for all kinds of service.

For high pressures or elevator service where the water is often oily, Jenkins Bros. No. 88 Pump Valves are especially recommended.

When ordering, state kind of service the valves are to be used in.

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